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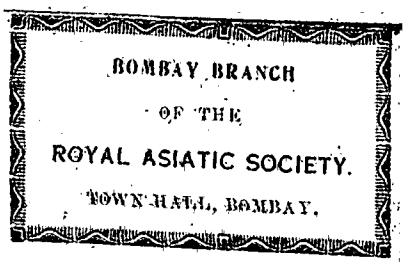


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# HANDBOOK

OF

# ZOOLOGY.

# HANDBOOK

OF

# ZOOLOGY

BY


## J. VAN DER HOEVEN,

PHIL. NAT. ET M.D. PROFESSOR OF ZOOLOGY IN THE UNIVERSITY OF LEYDEN, KNIGHT OF THE ORDER OF THE DUTCH LION AND OF THE SWEDISH ORDER OF THE POLAR STAR, MEMBER OF THE ROYAL ACADEMY OF SCIENCES, OF THE DUTCH SOCIETY OF SCIENCES AT HAARLEM, OF THE IMPERIAL LEOPOLDO-CAROLINE ACADEMY, OF THE IMPERIAL SOCIETY OF NATURALISTS AT MOSCOW, CORRESPONDING MEMBER OF THE BRITISH ASSOCIATION, OF THE ROYAL ACADEMY OF SCIENCES AT TURIN, OF THE ROYAL ACADEMY AT PARIS, ETC.


Trado quæ potui.

IN TWO VOLUMES.

VOLUME THE FIRST.

*(INVERTEBRATE ANIMALS.)*

TRANSLATED FROM THE SECOND DUTCH EDITION

BY


THE REV. WILLIAM CLARK, M.D. F.R.S. &c.

LATE FELLOW OF TRINITY COLLEGE, AND PROFESSOR OF ANATOMY IN THE UNIVERSITY OF CAMBRIDGE.



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# PREFACE.

THE first Edition of Professor VAN DER HOEVEN'S manual was published in parts between the years 1827 and 1835. He undertook the labour, as he informs us, not with any desire to add one more to the numerous works with a similar title already in existence, which should be neither better nor worse than these. On the contrary, if he had found any one of them to be a sufficient guide for his public teaching, without great alterations, he would have abstained from his contemplated task. Accordingly, the plan of his work differed from that of most other manuals in beginning with the simpler forms of animals, and proceeding upwards to the highest: and from that of all of them, in embodying a much larger amount of anatomical information. His work was received with marked approbation not confined to the limits of his own country. During the lapse of nineteen years, which intervened between the first and second editions, the acquisitions both of Zoology and Zootomy had been greatly enlarged, so that in many departments the former science had assumed an entirely new aspect. Consequently the second

edition, similar in plan to the first but greatly different in its contents, was almost entirely re-written. This edition has, like the first, been published in parts between the years 1846 and 1855, inclusive. From the high terms in which it has already been alluded to from time to time, in the writings of various active cultivators of different departments of Zoology on the continent, it is obvious that the general estimation of his work will still be such as might be expected in the case of an author of vast erudition, of appropriate tastes, talents and genius, and whose office it has been for nearly thirty years, as Professor of Zoology in the University of Leyden, to bring the value and import of the new acquisitions of Anatomy and Zoology (many of them the result of his own labours) from time to time before his auditors.

The University of Cambridge, a few years ago, directed in a more marked manner the attention of our students to the Moral and Natural Sciences, by proposing honorary distinctions to those who might excel in certain departments of those sciences respectively; and by requiring proof of satisfactory attention to some one at least of such departments on the part of all candidates for the degree of Bachelor of Arts, who were not aspirants for Mathematical honours. Amongst the departments of Natural Science, Comparative Anatomy and Physiology were indicated, with special regard (as is presumed) to Zoology. It thus became a part of my office to place within reach

of our students the best assistance I could recommend for their studies in this direction. In fulfilment of it I applied to Professor VAN DER HOEVEN for his permission to translate his Work, in which I found all that could be required. He had the kindness not only to grant this permission, but also to enrich the English translation with numerous references to works too recent for notice in his own second edition. It is to be much regretted that his other engagements did not allow him, as I requested, to weave the new matter in his own terse and pleasing style into his introductions to the classes and elsewhere. Consequently such additions, in this respect, as are included within square brackets are mine.

The study of Zoology is now in such general favour with cultivated persons in this country, that I believe the present work, from its scientific value and the interest of its historical and other notices, as well as from the continuous references to the works of the original discoverers, will secure for itself, beyond the walls of Universities, a reception not unworthy of its Author's great name.

W. C.

CAMBRIDGE, *July* 1, 1856.

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|---|---|---|---|
| 5 | 15 | SCHWAMMERDAM | SWAMMERDAM. |
| 16 | 3 | arterial | venous. |
| 23 | 7 | Sœmmering | Sœmmerring. |
| 27 | 13 | called varieties. | constitute varieties. |
| 32 | 12 | worse | now more usual. |
| 67 | 4 from bottom | consequence of | after the. |
| 79 | 5 from bottom | millim. | metre. |
| 87 | 19 | *Fungina* LAM. | *Fungia* LAM. |
| 89 | 13, 14 | might perhaps, &c. | seems to require new observations before it can be established with propriety. |
| 212 | 6 | mammals | vertebrates. |
| 257 | 12 from bottom | take scarcely any | require no. |
| 263, note 2. | | VAUGUELIN | VAUQUELIN. |
| 299 | 10 | *Sminthurus.* | *Smynthurus.* |
| 412 | 8 from bottom | pupa | larva. |
| 428 | 13 from bottom | *hymenoptera* | *hemiptera.* |
| 494 | 7 | *Heleus* | *Helœus.* |
| 672 | 10 from bottom | *Droma* | *Dromia.* |

The following, not considered distinct genera, but divisions of the genus immediately above each respectively, ought to have been printed in the smaller type used:

| | PAGE | | PAGE |
|---|---|---|---|
| *Cothurnia* EHRENB. . . . | 58 | *Apis* LATR. . . . | 352 |
| *Corallium* LAM. . . . | 83 | *Melliturga* LATR. . . | 356 |
| *Melitœa* LAM. . . . . | 83 | *Polistes* LATR. . . . | 362 |
| *Isis* LAM. . . . . | 83 | *Labidus* JURINE . . | 366 |
| *Fungia* LAM. . . . . | 87 | *Bethylus* LATR. . . . | 375 |
| *Ammotrypana* RATHKE . . | 238 | *Ellopia* TREITSCHKE. . | 397 |
| *Ophelia* SAV. . . . . | 238 | *Euclidia* OCHSENH. . . | 399 |
| *Euphrosyne* SAV. . . . | 244 | *Plusia* OCHSENH. . . | 399 |
| *Amphinome* AUD. and EDW. . | 244 | *Helœus* LATR. . . . | 494 |
| *Chloeia* SAV. . . . . | 244 | *Platyarthrus* BRANDT . | 651 |
| *Curtocera* MACQ. . . . | 323 | *Trichoniscus* BRANDT . | 651 |
| *Anopheles* MEIG. . . . | 346 | *Crossurus* RATHKE . . | 654 |

The following distinct genus ought to have been printed in the larger type:

*Siphonaria* SOW. p. 795.

# INTRODUCTION.

WE often hear the word Nature used in such a way that it is difficult to know what meaning is attached to it. Some denote thereby the system of all the forces to which matter is subjected, and thus distinguish between Nature and the Universe; understanding by the last the entire complex of created bodies. But such a distinction is quite arbitrary. The word Nature, introduced into modern languages from the Latin, is derived from *nasci, to be born, to come into being*[1]. In this sense we call the aggregate of all that comes, or has come, into being, and is for us an object of observation either by external sense or internal perception, Nature—the material world and the spiritual world—Nature in space and Nature in thought. Finally we oppose Nature to Art, understanding by the last whatever change the intellect of man has induced upon the products of Creation, in order to satisfy his wants, or to enhance his enjoyments.

However different these and other meanings may be, we may admit that to be the most general which defines nature as the material world, the world of matter, all that is created or has being, together with the forces inherent in the matter, and the laws according to which they act. The knowledge of this whole, so stupendously vast, the ancients named *physica:* and considered to be a part of the philosophy which they termed a science of divine and human things and of their causes. But though this science, like nature its object, be one, yet its great extent on the one hand and the narrowness of the human intellect on the other, has rendered the subdivision of it necessary. Yet the limits of the different natural sciences can scarcely, on account of their mutual relations,

[1] So the Greek φύσις from φύω.

be defined with precision: and into whatever path we chance to strike, difficulties from the very nature of the case are unavoidable.

The Natural Sciences relate either to Nature and her several products considered by themselves: or they teach us so to apply those products as to contribute to our service, or to satisfy our wants. The latter are called *practical* natural sciences, the former *theoretical*. To the practical natural sciences belong especially Agriculture and Technology: and they are founded upon the theoretical, of which the truths are applied only in a degree proportioned to the particular object that is had in view. They may therefore be called Applied Natural Sciences. Of the pure, or theoretical Natural Sciences there are several. To them belong[1] Phænomenal Doctrine, Chemistry, and Natural History. What characterises such sciences and distinguishes them from each other lies less in the objects which belong to the province of each, than in the manner of considering them, and in the different direction of the enquiry. Metals, salts, earths belong as much to the province of Chemistry as to that of Natural History: but the chemist, in all these things, investigates only the matter and its properties, its affinities and combinations: the mineralogist is busied with their form, their natural occurrence, their classification. The chemist, moreover, investigates those elements which occur in nature only in combination with other matters: such elementary substances are excluded from the province of Natural History.

Whilst Physics investigate the common properties of bodies, and the motions by which a temporary change is effected in their condition, Chemistry enquires into their component parts, the special properties of each elementary substance, and its various combinations with other elementary substances. Natural History, finally, arranges the bodies occurring in Nature according to form. In a certain sense, therefore, it may be termed a special Phænomenal Doctrine: but its essence lies in describing and classifying. It is ordinarily limited to the bodies which occur upon the surface of our earth, or at small depths below and accessible by mining: but it is by no means necessary thus to limit it. It depends upon the

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[1] [*Natur-lehre*, The vast body of observed facts throughout nature "bound together under the form of laws and principles." Vid. WHEWELL'S *History of the Inductive Sciences*, and his *Philosophy of the Inductive Sciences*, passim.] *Tr.*

manner of treating it alone, to include within its province not only the planet which we inhabit, but even the whole visible universe[1].

The certainty to which we can attain in this science is grounded upon the testimony of our own senses, on that of other observers, and upon conclusions, drawn from the combination of particular observations (*Induction*): of which conclusions the security is increased in proportion to the number of observed phænomena which tend to their establishment; for observation is the principal foundation upon which this science is raised.

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### *Organic and Inorganic Bodies.*

A primary division of the bodies of our earth is that according to which they are separated into *organic* (*organica*), and *inorganic* (*anorganica*). Inorganic bodies can grow, or increase in bulk, only by external addition of homogeneous parts; they possess no heterogeneous parts, though they may be composed of several chemical elements. In their perfect condition they ordinarily present regular forms, which are bounded by planes and straight lines. The knowledge of them is the object of Mineralogy.

The remaining bodies are called organic, because they consist of different parts, of fibres, vessels, cells, &c., the combination of which is called *organisation*. In these bodies there prevails that mutual dependence between all the parts, of which, in the inorganic, we recognise no trace. In these last, each of the parts exists for itself, and when separated from the whole does not cease to be the same that the whole was before. As to form, the boundaries which circumscribe plants and animals are very generally round surfaces and curved lines, very rarely straight lines and planes.

Organic beings present phænomena which are called 'Vital Phænomena,' of which the most general consist in an incessant susception of new matters, in the formation of new parts and organs (Growth, Development, Reproduction), and in the production of similar beings (Propagation). The separation of those constituents of food that are unfit for nutriment, and of matters that have been changed through the action of life, and are no longer fitted for

[1] *Cosmographia, Historia Mundi.*

its support, supplies the means by which the peculiar chemical composition, characteristic of each individual being, is preserved; at death, on the cessation of this interchange of matter, the organic substance passes into solution or putrefaction. Instead of those complex combinations of elements, which form the proximate constituents of organic bodies, simpler combinations arise, which being taken up by the air or the earth, become anew the vital stimulants and the nutriment of that vegetable world, on whose existence the life of animals is dependent. Thus we perceive here an interchange of matter on a large scale, as we do in every organic being on a small one: and perishableness becomes the means whereby new life and fresh youth are effused over the whole of nature[1].

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### *Plants and Animals.*

The above may suffice to give a general notion of organised bodies. It scarcely requires notice that the term includes *plants* and *animals*.

At first sight it seems easy to distinguish an animal from a plant: and even the most unskilled person thinks he has a clear notion of the difference. Yet it is just his want of knowledge that causes the difference to appear so prominent: whilst he overlooks the intermediate links, and thinks, for instance, of a dog and a pear-tree. There are two sorts of judgment with conviction. Such a judgment may arise either from want of knowledge, or from profound insight, the result of long and accurate investigation. Whoever seeks after truth must learn to sacrifice the first, even though he may never attain to the second.

Animals are usually considered as more composite and more perfect than plants. Yet when we compare the simple substance of which Infusory Animals and Polypi are composed with the orderly and beautiful structure of the higher plants, we become satisfied that this proposition is far from having a general value.

It is said, plants are rooted in the ground, and by this token are sufficiently distinguished from animals. But it is here overlooked, that there are free-swimming water-plants, just as there are

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[1] "*Ut opus naturæ perenni flore rideat.*" LINNÆUS.

animals that live in water fast fixed to a given spot. Again, it was imagined that plants might be distinguished from animals by their possessing only at certain times the parts which serve for the maintenance of the species. But all animals have not organs of propagation during the whole of their existence: insects acquire them only in the latest period of their lives, like plants that only flower once. It is true that Anatomy points out the rudiments of these future organs in the Larvæ of Insects: but this does not prevent the Larvæ of Insects from being termed, in a certain sense, sex-less. Moreover many plants and animals are propagated only by spontaneous fission, or by buds, without possessing proper parts subservient to propagation. To me the difference of Nutrition appears of more importance. It has been observed that Plants live on inorganic matters, Animals, on the other hand, on organic. Some animals, it is true, seem to live on earth. SCHWAMMERDAM believes mud to be the nutrient matter of the worm or larva of the *Ephemera*, and never found any other food in its intestinal canal. PALLAS could find nothing but fine sand in the intestine of *Thalassema echiurus*. I might allege several other examples, but will only add that man himself sometimes lives upon earth. At least the celebrated HUMBOLDT tells of a people on the banks of the *Oronoco* and *Meta* that, when the waters are low, live upon fish and turtle: but as soon as the streams begin to swell and fishing to become laborious, devour, during a season which lasts for two or three months, enormous quantities of earth. The earth which these people eat is a fat soft clay, which they knead into lumps and burn on the outside at a slow fire, and again moisten when required for use. This observation however, now that microscopic investigation has discovered in different deposits and kinds of earth entire strata of living or fossil organic beings, admits of another explanation[1]. That earth may have contained organic constituents, as was the case with the earth that, mixed with meal and leaves of trees, was baked for bread on the failure of the crops in the year 1832 in the north of *Skandinavia*, and in which RETZIUS discovered nineteen different forms of Infusories, or rather of the fossil remains of these animals. In the same way, the mud and sand, found in the intes-

[1] Comp. EHRENBERG, *Das unsichtbar wirkende organische Leben*. Leipzig, 1842. pp. 41, 42.

tinal canal of insects and worms, can scarcely be devoid of organic components. In general it cannot be contested that the vegetable kingdom prepares from inorganic nature those substances which serve for nutriment to the animal kingdom. Albumen and Fibrin, the principal constituents of the blood of animals, are already present in the parts of plants which they consume. But still, on the other hand, there are plants which grow on other plants, and thus apply to their own development the matters which have been prepared by those organic bodies.

Scruples arising from such considerations must not mislead us to consider plants and animals as belonging to one and the same kingdom. Perhaps the following remarks may help to distinguish them from each other.

If we consider the nutrition, we perceive that animals convey their food by one or more apertures into a common cavity, the stomach or intestinal canal, from which the prepared matters are absorbed and applied to the nutrition of the whole body. Thus the intestinal canal is for animals what the soil and air are for plants. The plant is consequently so constructed that its surface has the greatest possible extension: in the animal all is contrived for union round a center. Moreover the plant, which receives nutriment by means of its surface and the parts there situated, (pores, hairs, &c.) has no need to seek for food: it lives in the midst of its food: when this is deficient it cannot move and must consequently die. The animal, on the contrary, is destined to seek its food, which it must conduct into its intestinal canal: it moves therefore when nutriment is deficient. Let it not be here objected that plants move towards the light, and send larger roots towards the side where moisture is more abundant—for this would be to confound growth with motion. The stimulants (light, moisture, &c.) act upon the plant, and therefore its growth is more vigorous in that direction. The animal has independent motion which is excited by internal stimuli. Hence sensation is ascribed to animals. In the higher animals it is known that the contraction of the muscles is under the influence of the nervous system: that the stimuli, of whatever kind, if they produce motion, act upon the nerves and through these upon the muscles. Comparative Anatomy, it is true, has, in some animals, hitherto failed to demonstrate a nervous system; but it does not therefore follow that these animals do not possess sensation, any

more than it follows that their want of muscular fibre justifies us in denying to them voluntary motion, which the unprejudiced observer may recognise even in the most simple animals.

As to chemical composition—Nitrogen, it is true, is not exclusively an animal principle: but still it occurs as an ultimate constituent of animal organisation in much greater quantity than in plants. In plants, on the other hand, Carbon is predominant.

Not long ago, it was believed that a transition from Plant-Life to Animal-Life had been observed[1]. L. C. TREVIRANUS had remarked that the spores of Confervæ move like Infusories[2]. A few years since UNGER described this phenomenon in *Vaucheria clavata*, and thought that he had surprised plants at the very moment of their becoming animals[3]. These *sporidia* move by means of *cilia*, but cannot on that account be considered animals[4]. Rather ought we, from such instances, to conclude that cilia are no exclusive character of the animal kingdom. The same may be said of a similar motion which GRANT observed in sponges, which, as little, on that account, are animals.

As we have already remarked above, the difference between plants and animals will always be more apparent as the organisation becomes more perfect and more complicated: the difficulty occurs in the case of the most simple vegetable and animal forms; and here may be applied what Ovid says of the change of colour in the rainbow,

> Usque adeo quod tangit idem est, tamen ultima distant.—
> *Met.* VI. 67.

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## *Zoology.*

There are three parts of Natural History, as there are three great divisions of the bodies which occur on our Earth. We separate Natural History into Mineralogy, Botany and Zoology, as we

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[1] See the earlier observations on this point in G. R. TREVIRANUS' *Biologie, oder Philosophie der lebenden Natur.* 8vo. II. p. 344.

[2] *Beiträge zur Pflanzenphysiologie.* Göttingen, 1811. 8vo. pp. 78, 79.

[3] *Die Pflanze im Momente der Thierwerdung.* Wien. 1843. 8vo.

[4] C. DE SIEBOLD, *Diss. de finibus inter regnum animale et vegetabile constituendis.* Erlangæ, 1844. 4to.

divide nature into three kingdoms, that of minerals, of plants, and of animals.

As the history of mankind does not result from a collection of biographies, so Natural History is not formed by the description of animal species. Therefore Zoology describes not merely the separate animals (*monographically*) according to external parts and internal structure, but it comprises the entire kingdom of animals, denotes their mutual relations, and assigns to each animal its rank and position.

Zoology falls into different parts. First, it is divided into *Description* and *History*. Description of animals (*zoographia*) supplies precise descriptions of the separate internal and external parts of the animal body, and thus of the entire animal. In a narrower sense, it makes us acquainted with the external parts and the external form of the animal, and with the distribution into classes and orders. When it makes us acquainted with the internal structure of animals, as well in respect of form and position (*structura*) as of tissue (*textura*), it is called the *Anatomy of Animals* (*Zootomia*), which has been especially cultivated of late years, and is generally named *Comparative Anatomy* (*Anatomia Comparata*). But this appellation has not exactly the same meaning as the first: it denotes, rather, a philosophical science, which, not content with the simple knowledge of the different forms, investigates, by comparison of the anatomy of all animals and also of the human body, the general laws of animal organisation and its unity.

The History of Animals (*Historia Animalium*) comprehends a comparative history of the nature and intellect of animals: it illustrates the phænomena of life, and their obedience to law in the animal economy. It may be also termed *General Physiology* (*Biology*). The knowledge of the geographical and physical distribution of animals over the surface of the earth, the knowledge of the series of forms which in earlier periods inhabited our planet, and of which the remains have been found in beds and strata of rocks deposited from water, also belong to the History of the Animal Kingdom.

These subdivisions cannot dispense with mutual assistance. Conjointly they form only one science which we term *Zoology*.

## *The Tissues of Animals.*

Nature, in the structure of animals, has exhibited inconceivable resources of art. Not only is the body as a whole, not only are its grosser parts, but even the smallest parts of the organs are machinery; and the knife of the anatomist exhibits to us, even to the simplest fibre, nothing but parts constructed for a purpose. The whole body consists of many members: the members themselves consist of muscles, vessels, and nerves; the muscles again of tissues, vessels, fibres, &c. Such a body may well be called *organised.*

In order to form an idea of the texture of animals, we must go to work as the chemist does. He divides the parts which compose bodies into proximate and ultimate constituents, and terms those constituents ultimate, or elements (*elementa*), which by his art he can separate no further into heterogeneous parts. In the same way we find in the textures of animals proximate and ultimate constituents. Of the last, or the organic elements (*elementa organica*), we shall speak hereafter: the first question is—what are the proximate constituents? (*partes constituentes proximæ*). They are called Tissues (*Telæ*).

BICHÂT was the founder of the science of the organic tissues in man, and named it *General Anatomy.* In the investigation of the tissues he had recourse to chemical reagents, to maceration and partial decomposition in water. He described each tissue according to its physical and chemical properties, its physiological phænomena and its morbid changes. After him this science was advanced by MECKEL, HEUSINGER, and BÉCLARD[1] in the same spirit. Within the last ten years it has received a totally different direction through microscopic research. By means of it General Anatomy has become, for the most part, Microscopic Anatomy. Our immortal LEEUWENHOECK, about a century and a half ago, had collected much material which remained almost unused; until, in our day, with the improvement of the compound microscope, a more general interest in such enquiries has been excited, and the importance of the knowledge of the minutest organic constituents to accurate

[1] Here it may suffice to refer to the well-written and succinct manual of the last named author: *Elémens d'Anatomie générale* (2me édit. Paris, 1827. 8vo.)

Physiology been gradually recognised. We cannot omit mentioning the names of KRAUSE, VALENTIN, SCHWANN, HENLE in preference to many others whom we could willingly refer to in this field of enquiry[1]. We must limit ourselves to a short survey, and will rather enumerate than describe the different Tissues. A complete description, however compressed, would demand more space than is consistent with the nature of this manual.

I. *Conjunctive Tissue* (*tela conjunctiva*), ordinarily *Cellular Membrane* or *Areolar Tissue*, called also by others *Formative Tissue*, occupies almost everywhere the space between the different parts, and forms, according to Cuvier's well-selected comparison, a kind of sponge, which has the same shape as the whole body which it contributes to form. By long boiling it is dissolved into glue. It consists of bundles of threads, and has no resemblance to the cellular tissue of plants which consists of hexagonal cells. The threads are long, have a somewhat tortuous course and an extreme tenuity (about $\frac{1}{1000}$ millim.)[2].

II. *Adipose Tissue* (*tela adiposa*). Formerly this constituent was not distinguished from the former; it was considered to be cellular tissue containing fat. But it is quite necessary to distinguish between them. This tissue consists of vesicles or cells, which, compared with other elementary parts of the animal body, are pretty large (about $\frac{1}{25}$ ... $\frac{1}{12}$ millim.). Fat is, with the exception of some constituents of milk in the class mammalia, the only non-azotized substance of the animal body and, like most vegetable constituents, rich in Carbon. Fat, except in situations where it occurs as a distinct membrane, forms in the combined state a constituent of different tissues and of many animal fluids.

III. *Vascular Tissue* (*tela vascularis*). Vessels are hollow cylinders, which contain nutrient fluids that circulate through the body. To these belong the Lymphatics as well as the blood-vessels. The larger blood-vessels are composed of

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[1] Here too it may suffice to refer to a single work of eminence. J. HENLE, *Algemeine Anatomie, Lehre von der Mischung's-und Formbestandtheilen des menschlichen Körpers.* Leipzig, 1841. 8vo.

[2] A millimeter is about half an English line, or the 24th part of an inch.]

different layers: the finest vessels (called Capillaries) of a single uniform membrane, without fibres or other tissue, but in which lie round or oblong microscopic corpuscles (cell-nuclei). In the larger blood-vessels, and also in the lymphatics, the innermost coat is formed of cells, which, as in the Cuticle, lie side by side, pavement-fashion. This coat is covered by others which present fibres partly longitudinal, partly circular. Then comes the most external layer of conjunctive tissue, which connects the vessels with the neighbouring parts.

IV. *Nervous Tissue* (*tela nervea*). To this belongs in the higher animals, the brain, the spinal cord, the ganglia and the nerves: inferior animals have only nerves and ganglia, which last take the place of the central parts of the nervous system. The chemical constituents of this tissue are Albumen and a species of Fat containing Phosphorus. The nerve-stems and the bundles of which they consist, are surrounded with coats of conjunctive tissue, called *Neurilema:* dilute muriatic acid dissolves the neurilema: alkaline solutions, on the contrary, cause the nervous medulla to disappear, the neurilema remaining alone. The nerves consist of fine threads, which neither subdivide, nor anastomose with each other. They are of very unequal thickness, $\frac{1}{56}$... to $\frac{1}{120}$ millim. and less, especially in the nerves of sense. Besides these threads there are found corpuscles with nuclei: these present themselves in the ganglia and in the grey substance of the brain and spinal cord. These ganglion-corpuscles are very dissimilar in form and size, mostly $\frac{1}{20}$... $\frac{1}{50}$ millim.

V. *Horny Tissue* (*tela cornea*). The parts consisting of this tissue have neither blood-vessels nor nerves. Cuticle, nails, hair, feathers, horns and scales belong hereto. They lie on the surface of the body, whilst a covering (*epithelium*), resembling Cuticle, lines the inner surface of the mucous membranes (as of the stomach) and also of the internal closed cavities and sacs, as well as of the vessels (see above, III. *Vasc. Tis.*). The Cuticle, or Epidermis, consists of microscopic flat cells joining on to each other like a pavement, and of which each contains a nucleus. Water swells up the epidermis,

boiling leaves it unchanged, by concentrated sulphuric acid it is dissolved gradually, by alkalis readily. Scales, nails, &c., which consist of this tissue, are secreted by a highly vascular bed (*matrix*) in layers. The *Epithelium* is formed in part, like the Epidermis, of flat cells: in other situations these cells are cylindrical, or conical, and stand perpendicularly, side by side, like fibres. In many situations (as the nasal cavities, the respiratory organs of mammalia, birds and reptiles, the gills of bivalve molluscs) these conical cells carry cilia, whose motions had been seen on the surface of the body of many of the lower animals by the earlier observers, but were distinctly recognised by PURKINJE and VALENTIN as a very general phænomenon of the animal kingdom only a few years ago.

VI. *Cartilaginous Tissue* (*tela cartilaginea*) is semi-transparent, elastic, and mostly of a bluish-white colour. On section it presents a very smooth surface and looks like a substance of uniform density. But under the microscope, small, granular, round or oblong corpuscles are seen in the clearer transparent principal mass. The glue which is obtained from cartilage by boiling differs in many respects from the glue of bone, and was called by MUELLER, who first called attention to the difference, *Chondrine* (*cartilage-glue*). This glue is also obtained from the *cornea* of the eye, which is composed of many thin layers or plates formed of fibres that cross one another in all directions. Certain yellow highly flexible and elastic cartilages contain numerous fibres (*cartilagines fibrosæ*): to this division belongs *ex. gr.* the cartilage of the external ear in man and mammalia. Cartilage contains two-thirds of its weight of water. In the ash are found carb. soda, sulph. soda, and carb. lime as the chief constituents. Here belongs:

*Osseous Tissue* (*tela ossea*). The tissue of bone is hard and opaque, and of a laminated structure. The chief constituents are *cartilage*, which on boiling passes entirely into gelatin or common glue: and bone-earth, of which the quantity increases with the age. The last consists principally of phosphate of lime, which has a great affinity with the colouring matter of madder, so that the bones of animals

fed on it acquire a red colour. Bone may be freed of its lime by acids (*ex. gr.* dilute muriatic acid). The cartilage which remains has in general the structure of permanent cartilage: the bones also, in the first period of life, correspond to cartilage, and previous to ossification (*i. e.* before the bone is hardened by the phosphate of lime) the glue which they contain is also *Chondrine*, which is precipitated by alum, acetic acid and the sulphate of alumina. In the bones are found small medullary canals communicating with one another ($\frac{1}{45}$...$\frac{1}{11}$ millim.) which are connected with the medullary cavities, or the cellular spaces in the middle of the bone, and give to the bone a streaky or fibrous appearance visible to the naked eye. These canals are surrounded by several layers, which lie included between the other layers or plates that, in the flat bones, are arranged in the direction of their surface, and in the long bones in a circular form round their internal medullary cavity. These medullary canals contain fat and minute blood-vessels. Between the layers are found microscopically small oval corpuscles, resembling cartilage-corpuscles, and from which extremely fine tubules, partly branching, proceed. These parts, when treated with acids, become quite transparent, and their granular content is consequently bone-earth.

VII. *Muscular Tissue* (*tela muscularis*). Muscles consist of bundles of fibres: the primitive bundles, which consist of some hundreds of fibres, are by means of conjunctive tissue (cellular tissue) collected into larger bundles, and these again into still larger. Muscular tissue belongs to the albuminous substances. Flesh becomes harder by boiling: on cooling the decoction becomes gelatinous from the glue into which the cellular tissue has been changed. If finely-divided flesh be pressed, a red acid fluid is obtained, which contains albumen, the colouring matter of blood, lactic acid, salts, and ozmazom. The red colour of muscles (in animals that breathe by lungs) is heightened by exposure to light; some ascribe this solely to the blood. It is not a common character of this tissue: in fishes the flesh is white: the muscles of many articulata are brownish, yellow, or light red. Muscles are distinguished into two kinds. There are

muscles with varicose structure of the primitive fibres, and fine transverse stripes of the primitive bundles. This is the structure of the muscles of voluntary motion amongst vertebrate and articulate animals, and of the muscles of the heart. These fibres are very fine, $\frac{1}{700}$ millim. and less, and are amongst the finest parts of the animal organism. Other muscles consist of coarser fibres $\frac{1}{160} \ldots \frac{1}{260}$ millim. which are not jointed or varicose, and which correspond to the primitive bundles of the former. In these therefore no transverse stripes are seen. To these belong the muscular fibres of the intestinal canal, also the red fibres of the muscular stomach of birds. Usually these muscles of organic life have a pale and somewhat yellow colour. Muscular tissue has the property of contracting, upon the application of a stimulus, in the direction of its fibres. This irritability (*irritabilitas*) is a vital property, and is distinct from the elastic contractility, which other parts of the body retain even after death.

VIII. *Elastic Tissue* (*tela elastica*). This tissue has much resemblance to conjunctive tissue, and holds, as it were, an intermediate position between it and muscular tissue. The fibres are of unequal size ($\frac{1}{150} \ldots \frac{1}{600}$ millim.) and have a serpentine course: they divide frequently and unite at many points with branches from other fibres, whence a reticulate distribution arises. The colour of this tissue is yellow: it retains its elasticity unaltered by keeping in spirit of wine, or by boiling for several days. After long boiling it gives a small quantity of a peculiar glue which in some points agrees with cartilage-glue. The cervical ligament of mammals is composed of this tissue: also in arteries a layer of elastic fibres lies between the circular fibrous coat and the external coat of cellular tissue: in large trunks this layer may be clearly distinguished as a continuous membrane. The yellow ligaments on the arches of the vertebræ, and the ligaments of the trachea, also consist of elastic tissue. But not merely as separate ligaments or membranes, but also mingled with other tissues, elastic fibres are met with in different situations, as for instance, in serous membranes and in skin.

We have here spoken only of those tissues which occur most generally. We have not noticed Dental Tissue because, whilst we

treat of the entire animal kingdom, it occurs only partially. Other tissues, which ordinarily receive special notification, may be reduced to one or other of the foregoing. Tendinous Tissue belongs to Conjunctive Tissue, as does that of Skin proper (*corium*): to this also belongs in part Mucous Tissue (in the intestinal canal, &c.) The Serous Membranes merit a special mention. They serve to line cavities in the interior of the body, and ordinarily form sacs which are closed on every side. They, too, belong to Conjunctive Tissue, and are smooth only on their free surface, which is covered with an *epithelium*. This smooth surface secretes a serous fluid. We cannot admit a proper Glandular Tissue (*tela glandulosa*), as most authors do. Under the term Gland Anatomists arrange very different parts, of which the consideration belongs to special and descriptive Anatomy. Lymph-glands (*glandulæ lymphaticæ* s. *conglobatæ*) which are found only in higher animals, are round or oblong bodies of different size, in which one or more lymphatics are distributed; these tortuous branches are again collected into larger vessels, which pass out on the opposite side of the gland, to pursue their course onward: numerous blood-vessels, whose fineness exceeds that of the lymphatics, surround all these branches. Consequently lymph-glands are only vascular networks, and may be put on a level with the so-called *Retia Mirabilia* of the blood-vessels. In the class of Glands, moreover, are reckoned different parts of the animal body which, apart from their coverings, consist of conjunctive tissue, blood-vessels and nerves, and for the most part have an internal closed cavity which is filled with a granular fluid. Such are the Supra-renal Capsules, the Thyroïd gland, the Spleen, the Thymus gland. These are the parts which HEUSINGER comprises under the name of parenchymatous tissue—under which, however, he also classes other parts, as the Lymphatics and the Ovaries. Other authors style these parts Blood-glands (*ganglia sanguineo-vasculosa*), comparing them with the lymph-glands (*ganglia lymphatico-vasculosa*); but since these parts are not distinguished from others by their blood-vessels, the comparison is arbitrary. Finally, in a more special manner, the term gland is applied to those parts of the animal body which secrete a fluid that does not return into the current of the blood. These, in addition to lymphatics blood-vessels nerves and conjunctive tissue, have an efferent canal (*ductus excretorius*) formed of mucous membrane, for the

passage of the secreted fluid, which is conveyed into the intestinal canal or to the surface of the body. This efferent canal receives, like an arterial trunk, the finer canals which effect the secretion, and which are covered with *epithelium*. To such belong the kidneys, the liver, the salivary glands, &c.

From what has been said, it is obvious that we cannot adopt that division of the Tissues which an esteemed writer[1] has proposed: into simple, constituent, and compound tissues. Doubtless every muscle contains nerves and blood-vessels, but nerves and blood-vessels are not on that account constituents of *muscular tissue*. According to our view, every tissue is simple, but it may, either by itself, form special parts, or only in combination with other parts. The corneous tissue is the only one which comes under the first head: all other tissues form this or that part, only in combination with one another: nervous tissue, for instance, does not by itself form a nerve, but only in combination with conjunctive tissue and blood-vessels. Some of these compound tissues are distributed generally throughout the whole body, others are limited to certain parts. To the generally distributed belong conjunctive tissue, vascular tissue, and nervous tissue: the other tissues are appropriated to determinate parts of the body and have a greater self-subsistence, as cartilage tissue, muscular tissue, elastic tissue. This was the division formerly adopted by BICHÂT. Other divisions of the tissues, founded on chemical research, as into gelatinous and albuminous tissues, may have their use in Physiology, but are not to be considered as anatomical divisions.

The above tissues, then, build up the proximate organic constituents of the animal body. Formerly, when less weight was allowed to microscopic enquiry in general anatomy, the ultimate organic constituents in these tissues were neglected: but now their description forms a part of the description of the tissues themselves. In this way we have learnt to recognise in conjunctive tissue, in nerves, in muscles, &c. fibres as the ultimate elements of microscopic analysis: in cartilage, round or oblong corpuscles: in corneous and adipose tissues, cells. It may be asked, whether these organic elements can be deduced from one another; or, in other words, whether all the

[1] E. H. WEBER in the 4th edition of F. HILDEBRANDT'S *Handbuch der Anatomie des Menschen* revised by him. Braunschweig, 1830. 8. s. 169—178.

tissues proceed originally from homogeneous elements. FONTANA, and afterwards TREVIRANUS, busied themselves with this enquiry: TREVIRANUS believed that he was borne out in adopting a sameness of organic elements in all parts of the animal body, viz. globules and thin cylinders (elementary or primitive cylinders)[1]. According to others, these cylinders were by no means primitive, but consisted of globules arranged in a row: so that only globules, or round vesicles, remained for the elementary particles out of which, in fine, all the animal tissues were composed and formed. Subsequent enquiries proved, as indeed had been already surmised, that these vesicles were due merely to optical illusion[2]. Every one, who investigates the tissues with the excellent microscopes of the present time, will easily convince himself, that such parts no where exist as ultimate elements of organic animal matter.

Within the last few years, since regard has been paid in the investigation of the tissues to their origin and to their development, the problem has received quite a different treatment. That the tissues consist of different elementary parts, fibres, granules, cells, is plain from what has been said above; but it is another question whether these parts did not originally proceed from some common fundamental form, of which they are subsequent developments and modifications. Much had been already effected by scattered observations, but to SCHWANN is the distinction due of having established the original cellular structure of the different tissues, and, at the same time, the great similarity between the microscopic structure of Plants and Animals, of which DUTROCHET and RASPAIL had already a general notion[3]: our limits do not allow us to propound his views, to which the name of *Cell-Theory* has been given, in detail. We will give an outline of them, in a few words, with a notice of the modifications which, from later researches, they would seem to require.

The first elements of organic beings are cells. They have their

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[1] See *Vermischte Schriften anatomischen und physiologischen Inhalts von* G. R. *und* L. C. TREVIRANUS. 4to. I. Göttingen, 1816. s. 117—144. *Ueber die organische Elemente der thiereschen Körper.*

[2] MILNE EDWARDS. *Recherches microscopiques sur la structure intime des tissus organiques des Animaux. Annales des Sc. natur.* IX. 1826, p. 362—394. Pl. 50.

[3] *Mikroskopische Untersuchungen über die Uebereinstimmung in der Struktur und dem Wachsthum der Thiere und Pflanzen von* DR TH. SCHWANN. Berlin, 1839. 8vo.

origin in a formless matter (*Cytoblastema*, germ-substance of cells); what afterwards remains of this substance may be distinguished as Intercellular substance (*substantia intercellularis*). The cells are vesicles, and consist of a fine membrane which encloses a fluid often containing granules. For the most part these cells have a so-called *nucleus*, a small dark-coloured corpuscle, lying on the wall of the cell. In this nucleus a round spot has been distinguished and termed *nucleolus*. The formation of these cells seems to proceed not always in the same manner. According to SCHWANN a nucleolus arises first, round this a nucleus is formed as its envelope, by the aggregation of granules in the fluid germ-substance: at a slight distance from this nucleus there coagulates, as it were, a thin membrane, the Cell-wall, which at first is raised, like a watch-glass, on one side of the nucleus, and afterwards encloses it all round. On this account the nucleus is considered to be the germ of the cell (*Cytoblastus*); when the cell is formed, the nucleus, according to SCHWANN, has discharged its office: it is detached and disappears. The researches of HENLE[1] have shewn that such is not universally the case, but that in fibrous tissues formed from cells, the cell-nucleus is changed into peculiar fibres.

Cells when once formed are multiplied by fission, or by the formation of new cells within those already formed. The parts then of those tissues, with which we have become acquainted above, are either cells or fibres which have been formed from cells. (1) In some tissues the cells, which have been plainly isolated, are present as elements at a later period, as in adipose tissue and cuticle; (2) in other tissues the walls of the cells become thickened, and coalesce with one another and with the intercellular substance, whilst the cavities remain separate, as in cartilage; (3) in others, again, the cavities coalesce, whilst the walls of the cells that mutually touch, are destroyed or absorbed. Finally, other tissues, still, exhibit as elementary parts little plates without cavities, which may probably have existed at an earlier period. These either join one another in a plane, or range themselves lengthwise in a row, as in the fibres of organic muscles and of Conjunctive Tissue. Other fibres may, according to HENLE, be considered as compound cells, *i.e.* those whose nucleus was originally

[1] HENLE, *Allgemeine Anatomie*, s. 188—9.

a cell that has become enclosed by a wall or envelope of later formation. Muscles, according to SCHWANN, consist at first of nucleated cells which range themselves in a row; the nuclei adhere to the wall, and within the tube (of the primitive bundle) are formed the proper primitive fibres. According to VALENTIN and HENLE, on the other hand, the primitive fibres are arranged around the row of cells which occupies the middle of the primitive bundle, and the external covering of this bundle is a sheath formed afterwards. But these and other diverging views we cannot here develope more minutely.

If once the fundamental truth of SCHWANN'S doctrine be accepted, that cells are the original form of animal and vegetable tissues, then is it of subordinate importance whether this or that view in the case of particular tissues be adopted, and we may suppose, as, for example, in parts which are formed of plates in which there is no distinction of wall and cavity, that the cells have not been perfectly formed from the amorphous blastema, but were joined together before they possessed a cavity[1].

We must here add a word concerning the blood-corpuscles. They are flat vesicles, filled with the colouring matter of the blood: having in mammalia a round, in birds, reptiles, and most fishes, an oval outline. In man, the mean diameter is about $\frac{1}{150}$ millim. In reptiles, especially in those without scales, they are larger. In the frog, for instance, they have the length of three and the breadth of two human blood-corpuscles. Here a nucleus is present, of which the existence in mammalia is doubted by some writers. The blood-corpuscles, therefore, are cells: and we may consider the fluid, so rich in albumen and fibrin, in which they swim and with which, during life, they circulate (*liquor sanguinis*), as a liquid intercellular substance of the blood-cells.

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## *The Vital Functions of Animals.*

In order to complete the general idea which we ought to form of the animal body, we must not stop at the membranes, but must also look at the structure of the principal organs. We unite organs

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[1] HENLE, *Allg. Anat.* s. 188, 189.

and functions in our rapid sketch: and hasten to place before our readers a view of the whole.

The functions performed by animals may be brought into two chief classes. One class comprises the vegetative, the other the animal functions. The first are so called because they occur equally in plants, and are also, on that account, called organic functions. The last are peculiar to animals, and therefore are called animal functions.

To the organic functions belong Nutrition in the widest sense, and Propagation. To nutrition belong three systems: namely, that of Circulation, that of Assimilation, and that of Secretion. Respiration is a part of the system of secretion: for the object of respiration, like that of secretion, is the elimination of effete matter, its volatilization, or its separation in a more fixed form: and both, in this way, support that unceasing interchange of matter by which the circle of vital phænomena is characterised.

By means of these functions, which together are comprehended by the name of Nutrition, the life of the individual is secured and provided for. Other functions have reference to the life of the species, and ensure its existence after the death of the individual. These functions constitute Propagation, of which a part are discharged by the male individual, viz. the secretion of the impregnating fluid (*semen*), and its conveyance to germs capable of development. These germs are prepared and protected by the female individual, and on the union of these functions depends the being of *the Embryo*, the development of which is the final purpose of propagation.

To the animal functions also belong three systems: viz. the nervous system, that of the organs of sense, and that of the organs of motion.

The food, when solid, is comminuted by means of the jaws and teeth, or, when fluid, is imbibed. It is then conveyed into the intestinal canal, which ordinarily has an expansion called the stomach. Here and at other parts of the intestinal canal different solvent fluids are secreted for assisting the conversion of the food. The nutrient part of the food is thus separated from the rest and taken up by the surface of the inner wall of the canal consisting of formative tissue: the remainder is rejected as unfit for the support of the creature.

The tube in which this first process of nutrition is effected, is a continuation of the skin. In some very simple animals, where the whole body is composed of a homogeneous mass (ex. gr. in *Polyps*) there is properly no special intestinal canal. The body is simply excavated, and the internal surface has the same structure as the external. Such creatures may be turned inside out, like the finger of a glove, without dying in consequence: nutrition can proceed undisturbed. Such animals are entirely intestinal canal, independently vital stomachs. The external skin also corresponds in function with the surface of the canal. The skin has the function of Imbibition, which may be compared with absorption by the intestinal tube: and on the entire internal surface of the intestinal canal there is evaporation, which corresponds to that of the skin, and with the diminution of this increases.

In some very simple kinds of animal there is in the intestinal canal only a single opening, which allows the food to enter and the refuse to escape. In the rest the two openings are separate.

The Chyle, or nutrient juice which has been produced by digestion, is in many animals immediately poured into the formative tissue of the entire body, and so serves for the nutrition of the different parts. In others it is mixed with a nutrient fluid of higher rank, the blood, which circulates in a system of vessels; this motion is called *Circulation*. The vessels which carry the blood towards the parts are called *Arteries:* those which carry back the blood from the parts towards the center of the circulation are called *Veins*. This motion is ordinarily assisted and regulated by one or more muscular organs, called *Heart*. But the chyle is not sufficient to renew the venous blood and render it fit for the nutrition of the parts. It must be brought in contact with atmospheric air, and so be submitted to change before passing into the arterial stream. This function is called *Respiration*, and the mechanism for it is in different creatures so variously contrived, that it is often difficult to harmonise such variety with the poverty of our language, accustomed to include every form under *Gills* and *Lungs*. In the case of Lungs, the medium that serves for respiration, mostly air, penetrates the cavities whose external surface is bathed with blood. In the case of Gills, the medium, here mostly water, does not penetrate within the tissue, but only bathes the surface on which the blood-vessels are spread out. Gills have very different forms, as of

Plates, Leaves, Threads, Twigs, &c. Many simple and imperfect animals breathe by means of the skin. Others, which have either no circulation, or none that is perceptible, have *Air-Canals*, i. e. such respiratory organs as convey the air through the entire body to the nutrient fluid.

The nutrient fluid which has thus been separated from the food and changed by means of respiration, is now fit for the nutrition of the parts. How that nutrition is effected, so that every part receives from the common fluid that which is requisite for its support, is not known. Here we can only conjecture: and if any one chooses to call it a chemical affinity he is at liberty to do so, if he merely means that he is contemplating living creatures whose organism has a determinate chemical composition, and so does not forget that he has given a name to the process, but has not explained it.

Besides the glands which separate from the blood fluids for the internal economy, as the Liver, &c., there are others which separate constituents that must quit the blood in order that it may become more pure, or in order that the due proportion of its constituents may be preserved. Thus the kidneys secrete urine, the skin watery vapour, &c. Sometimes a secretion is a means of defence, as is the case with the Ink of the Cuttle-fish, and with the offensive exhalations of many animals, which thus repel their enemies or are avoided by them. Rightly to estimate all these secretions we must never forget that an animal is *a whole*, and that the secretion of this or that fluid, though it may be performed by an individual organ, is still under the control of all the other organs, and of life, which combines them all.

Propagation, which also belongs to the vegetative life, has the following organs for its instruments: the *ovary* (*ovarium*), by which we understand the site and the coverings of the eggs and the eggs themselves, conjointly; the *oviduct* (*oviductus*) or the tube, through which the eggs, that have been detached from the ovary, pass onwards: the *uterus*, a residence for the eggs during their development, and the *vagina* along which they pass to leave the body of the mother. In the case of two sexes, the male (by means of glands named *testiculi*) secretes the *seed* (*sperma*) which fertilizes the germs, and effects their development. *Pénis* is the name of the part, which, in some animals, conducts the seed into the vagina of the female.

With respect to the animal life—a perfect sensation appears to be possible only through a *Nervous System*. This nervous system, in the higher, or more perfect animals, consists principally of the brain and the spinal cord. The larger the mass of the brain is in proportion to the nerves, the more perfect appears to be the development of the intelligence and mental faculties of the animal—a law that was first discovered by the celebrated SŒMMERING. In proportion as we descend to the lower animals, the nervous masses are more dispersed and removed from one another, and in the lowest families of the animal kingdom no traces of a special nervous system remain.

The *Head* is that part of the body which includes the brain and the chief organs of sense. There are five senses, of which Touch (*tactus*) appears to be the most widely diffused through the whole animal kingdom. The seat of touch is the skin, the general covering of the body, which is everywhere interwoven with nerves. The nerves of the skin are lost, with their little twigs, in its middlemost and very dense layer. The ends of the cuticular nerves are covered and protected by the cuticle, and in many places by other external insensible parts, as scales, hair, &c. In the *organ of Taste*, the twigs of the nerves of taste pass into the soft papillæ of the tongue, and end there. The twigs of the *Olfactory Nerve* are spread out upon a mucous membrane (the *membrana Schneideriana*): the continuation of the medulla of the *Optic Nerve* forms the Retina, which Physiologists determine to be the seat of vision. Lastly, the most simple form of the *Auditory organ* is that of a sac filled with fluid, in which there float, as it were, the soft and delicate terminations of the auditory nerve. From all this it appears, that the general form (*typus*) of an organ of sense is to be sought for in a nerve whose terminations form a delicate mass suited to the reception of external impressions. But in each particular organ of sense the proper nerve of sense is only capable of a determinate action. The auditory nerve is only susceptible of sound, or rather, every stimulus which affects it is perceived only as sound: the optic nerve recognises no other impressions than those of light. Such, at least, is the case with man and the higher animals: and one organ of sense can never supply the proper office of another. Impressions are conveyed, by means of the nerves, to the brain or any other nervous center.

Thus nerves are the messengers by which the mind receives information of the external world (*nuntii rerum*).

But the nerves are equally the ministers of the will, which by their assistance is able to act upon the muscles. By Muscles are understood those active organs of motion (*organa motus activa*) which are fixed to other parts, as their point of resistance, and these last are called passive organs of motion (*organa motus passiva*). The harder fibres, which serve for the insertion of muscles, form *Tendons*, of which the colour in animals with red flesh, as in man, is white. In many animals the muscles are inserted into the skin, or into certain hard portions of the skin, as in Insects, whose hard and often horny coverings supply the place of a skeleton in that respect. A skeleton is, properly, a connected whole of internal *passive* organs of motion—cartilaginous or bony, and these serve not only for motion, but moreover, and indeed especially, for the protection of the most important parts of the nervous system, the Brain and Spinal Cord. The skull (for the protection of the Brain) and the Vertebral Column (which encloses the Spinal Cord) must therefore be considered as the principal parts of the skeleton, of which ribs and limbs are only appendages: in this simple condition is the skeleton met with in the Larva, for example, of the Frog.

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## *Development of Animals.*

### *How the expression* imperfect Animal *is to be understood.*

We have attempted to give a general idea of the organs which compose the animal body. But these organs are by no means found in all animals. Only in the more perfect animals is the structure thus complicated. When from these we descend in the animal scale, we perceive in the long series one instrument after another gradually decrease in magnitude and development, and at last entirely disappear. In Polyps (*hydræ*) nothing remains but the Intestinal Canal. The entire animal forms a blind sac composed of a single tissue, and all the vital functions which it performs are effected through one and the same gelatinous mass. Finally, in some Infusories we no longer perceive even an intestinal canal—nothing remains but an homogeneous gelatinous body, whose

surface appears to discharge the functions of absorption and nutrition.

A gradual course of development, similar to that observed in the animal series, is also pursued by the embryo of the more perfect animals. The whole Life is Metamorphosis; and there are animals in which the change of form is so great and so remarkable, that it does not escape even the eye of the multitude. Thus, for instance, a Caterpillar is changed into a Butterfly: a creeping, dull, voracious creature into one that flies and runs, and scarcely takes any food. In the same way the metamorphoses of Frogs are notorious. But there are other animals whose metamorphoses do not occur in so striking a manner, but are principally limited to the earliest periods of life. Every animal is slowly developed, and becomes more perfect as new organs are added to those already present. But this idea must not be so apprehended as if a Mammal, for instance, had been at first an Infusory, then a Polyp, a Medusa, afterwards an Insect, a Fish, a Bird, &c., as some express themselves[1]. This would be as extravagant as it is unfounded: but properly, as we conceive, many moderns assume that all the organs in different periods of life do pass through a development and metamorphosis, and that the structure of a perfect animal, in its fœtal state, is more simple, and corresponds with that of the lower animals of the same Type to which itself belongs. Thus the first rudiments of all vertebrate animals are similar, and the history of the development of the Chick may illustrate that of Mammals in the first periods. This is more than a phrase without proof: rather is it the result of very numerous observations—for instance, those on the Brain and the Heart in the human embryo—and we shall find it confirmed by frequent instances in the course of the present work.

We have already on various occasions made use of the terms 'imperfect' and 'perfect' animals, and shall have to use them often. But since every animal is perfect in its kind, the term

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[1] How this gradual progress of the embryo through the different gradations of the animal kingdom is to be understood cannot here be further particularized. Compare hereon C. F. KIELMEYER, *Ueber die Verhältnisse der organischen Kräfte unter einander in der Reihe der verschiedenen Organisationen.* Tubingen, 1814. 8vo. s. 38. The different works of CARUS, TIEDEMANN and J. F. MECKEL supply many examples of the application of this position.

requires some explanation. By perfect animals we understand those that, in the number and importance of their functions, and in the complicated structure of their organs, make an approach to Man: whilst those are called 'imperfect' whose simple organisation, and less numerous functions, remove them from that perfection of which Man supplies the pattern. In this sense, as I conceive, the expression may be well defended. ARISTOTLE says that in all other things we must proceed just as we do in the investigation of coins, comparing them individually with those which are best known to us: but man is necessarily the best known to us of all animals[1]. Let it be added, that Man is in fact the center of organisation to which the animals, like rays, may be considered to converge—and so is the union of what is most perfect and most beautiful in them all[2]. Hence animals which have a resemblance to man are, not without reason, styled perfect.

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*On the art of Classifying* (Taxinomia).

Such conceptions become still clearer by unfolding the art of Classifying. Classification and systematic division are indispensable in Natural History. How innumerable are the species of animals which are scattered over the surface of the earth! Each of these species has its country, its determinate form, its peculiar properties. How shall we attain to all this knowledge: how shall we turn to account the observations of earlier writers, how learn to what species they refer? how can we, in fine, communicate our own observations to others, unless we make use of a classification? Classifications then are as old as the study of Natural History, and their difference is to be sought in their more or less scientific foundation and plan.—By means of its systematic arrangement the study of Natural History obtains a more extensive influence upon our entire scientific cultivation, and in this respect it cannot be sufficiently recommended to young persons, in order that they may

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[1] Ὥσπερ γὰρ νομίσματα πρὸς τὸ αὐτοῖς ἕκαστον γνωριμώτατον δοκιμάζουσιν, οὕτω δὴ καὶ ἐν τοῖς ἄλλοις. Ὁ δ' ἄνθρωπος τῶν ζώων γνωριμώτατον ἡμῖν ἐξ ἀνάγκης ἐστίν.

[2] See J. G. HERDER'S *Ideen zur Philosophie der Geschichte der Menschen*. Carlsruhe, 1794. 1 Thl. s. 100—108.

accustom themselves to strict order in all their other branches of study.

The foundation of all Zoological division is the Species. By this is understood the assemblage of all the individuals which have more conformity to each other, than to other similar creatures; which, by means of mutual impregnation, can generate prolific individuals and propagate themselves by generation, so that it can be inferred from analogy that they all sprung from *a single* pair. By *specific character* is understood the collection of all the characteristics which are shewn to be permanent. Those characteristics, on the other hand, by which different individuals of a species vary amongst themselves, and which are attributable to deviation from species, are called *varieties*.

The causes of varieties consist in the influence of external circumstances, and in the mixture of other similar species. Differences from this last cause are called *Hybrids*. The form is here a combination of the two parents.

Such Hybrids appear to be limited, fabulous stories apart, to those species which have great mutual resemblance. They are in general not prolific—not able to continue their race. They occur therefore, beyond doubt, in a state of nature extremely rarely, and are rather the consequence of the constrained state of servitude in which our domestic animals exist. This cause therefore is not of a kind to disturb the regular course of nature and to endanger the preservation of the species. On the other hand, varieties produced by the influence of external circumstances, by climate, difference of food and mode of life, are able to engender young that are prolific. But they do not suggest any doubt that we ought, perchance, to receive them for species. It must moreover be remarked, that those varieties of ordinary species which on account of the pliancy of their organisation and their tenaciousness of life are able to live in every climate, and appear, for the most part, to have followed man over the entire surface of the earth, are the most striking and the most numerous.

By *Genus* is understood a second group formed by the union of like species, as the species was formed by that of like individuals. Species which in general have a striking resemblance in their organisation, form a genus. The idea of genus is so natural that we meet with traces of it even in the language of children. Still all genera are not natural. Many of them have been formed upon some

resemblances of species in one or another characteristic arbitrarily selected in disregard of the general impression of the external form, and in neglect of the precept of the immortal Linnæus that 'Character does not make Genus[1].' When a species deviates very much from all the others, even from those most resembling it, then a separate genus must be made of it. Hence there are genera which contain only a single species. The characters of a genus must be common to all the species contained in it, and can only be drawn from a comparative study of all those species.

This is the place to say a word concerning the *Nomenclature* of animals. LINNÆUS was the first who gave to every object in nature a double name: thus the Lion, for instance, is termed *Felis Leo*, the Dog *Canis familiaris*. The first of the two names (*felis*, *canis*) is that of the genus, and therefore common (*nomen genericum*) to all the species which belong to that genus. It must be a noun substantive. Different rules have been laid down for the formation of names: but to expound them would lead us too far away. Of late years, after the example of the Botanists, the names of persons have been adopted for the generic name, as *Bonellia*, *Boltenia*, *Dorthesia*, *Desoria*; but this is much more usual in botany. The second name is the *specific name*, as *Leo*, *familiaris*; it is either a substantive or an adjective, and in the latter case must agree in gender with the generic name. By itself it has no meaning, and indicates nothing until joined with the generic name[2]. This double name has thus an intimate connexion with the Idea of Genus.

Genera again, after a similar manner, are grouped together and formed into *Orders*, and these again into *Classes*. We may reverse the proposition and say that the Animal Kingdom is first divided into Classes, then into Orders and Genera, which last contain the Species.

We have now been taught to recognise the chief divisions. An arrangement which teaches us to find with ease the names of animals is called *a System*: which, according to Cuvier's apt comparison, is a dictionary, but with this difference, that here the

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[1] "Character non facit genus."

[2] It is the same with the family names and the prænomens of persons. The first indicate a family, the last acquaints us with a particular subject of the family: only their order is reversed: i. e. the baptismal name is placed first, and after it the family name.

properties serve us for finding out the name, whereas in ordinary dictionaries the known name serves to acquaint us with the properties. That a system may serve its purpose, and supply an easy means of finding the name, it must be artificial, i. e. it must be taken from a single system of organs and their differences. The characters should be easy to find out, and be borrowed from external parts. An example of such an artificial system is the sexual system of Linnæus. In the animal kingdom we have no such artificial system: most of the systems are mixed; neither entirely artificial nor entirely natural.

For there is yet another kind of systems, called *Natural systems* (*Method*): of which the chief object is, not so much to find the names readily, as to unite in an unconstrained manner those natural products which, in the greatest number of respects, correspond. They are founded, not on a single organ or system of organs, but on the whole structure. If an object be seen only on one side, on the north or south, east or west, just so many partial representations of it will be obtained as there are points of view: but he only who observes it in all directions is able to form a judgment of its nature and being. This is the advantage of a natural method over artificial systems: it does not forget the center in the circumference, but comprising all the parts and properties of animals in its estimate, it allots to them a place in the arrangement according to their structure and to the importance which belongs to them in the economy of nature, and so combines them in a great organic *whole*[1].

A perfectly natural classification has not yet been discovered: but we must continue to search after it, and to collect its scattered fragments. It is, according to LINNÆUS, the first object and the last of the hopes of the Botanist: it ought to be no less so of the Zoologist[2]. We please ourselves with the reflexion that we have approached nearer to this goal, now that men, especially in our century, have begun to investigate the internal structure of animals with the same curiosity and the same zeal with which, in the last century, after the example of LINNÆUS chiefly, they studied the

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[1] See J. SPIX, *Geschichte und Beurtheilung aller Systeme in der Zoologie*. Nürnberg, 1811. 8vo. s. 8—11.

[2] *Philosophia botanica*, § 77.

external form. Even LINNÆUS himself has declared that a natural classification of animals is indicated by their internal structure[1]. But if this natural system were quite perfect, it would not merely be a register of animals or a large lexicon, but a true image of the animal kingdom and a short survey of the entire science. The more nearly the science approaches this end, the greater will be its perfection.

We must here, in few words, mention some of the systems which have been proposed in Zoology.

Animals may be divided into Classes in different ways, and the differences amongst individual zoological systems are very remarkable. ARISTOTLE divided animals into those that have blood (ἔναιμα) and those that have not blood (ἄναιμα), and distributed these two chief divisions into lesser ones. PLINY founded his division upon the different elements in which animals reside, and distinguished these as *Terrestrial*, *Aquatic*, and *Volatile* animals. It would carry us too far from our object to enter more fully into these and other early attempts at classification. But we must not omit to notice the system of LINNÆUS, who threw a new light on every department of Natural History[2].

In his primary division of animals LINNÆUS was a follower of ARISTOTLE: he named however those animals which ARISTOTLE called bloodless, white-blooded: whilst of the rest the blood is red. The basis of his further division is taken from the Circulation of the Blood. Here follows a sketch of his system.

| | | | |
|---|---|---|---|
| Heart with 2 ventricles and 2 auricles; warm, red blood | viviparous | I. | *Mammalia.* |
| | oviparous | II. | *Birds.* |
| Heart with 1 ventricle and 1 auricle; cold, red blood | with lungs | III. | *Amphibia.* |
| | with gills | IV. | *Fishes.* |
| Heart with 1 ventricle, no auricle; cold, white blood | with antennæ | V. | *Insects.* |
| | with tentacula | VI. | *Worms.* |

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[1] "Divisio naturalis animalium ab interna structura indicatur." *System. Natur.* Tom. I. p. 19. Ed. XII.

[2] CAROLUS LINNÆUS, born at Stenbrohult in Southern Sweden, 1707, died 1778. Comp. on his momentous life RICHARD PULTENEY, *A general view of the Writings of Linnæus*, 2nd edit. London, 1781. D. H. STOVER'S *Leben des Ritters Carl von Linné*, 2 Thle. 8. Hamburg, 1792. *Egenhändiga Anteckningar af* CARL LINNÆUS *om sig sjelf, med anmerkningar och tilläg.* Upsala, 1823. 4to. (this is translated into German: C. VON LINNE *über sich selbst*, &c.) The first edition of his *Systema Naturæ* appeared

Thus LINNÆUS adopts six classes, of which the differences, though founded on internal structure, have still reference to the function of a part which is by no means common to all animals. The number of LINNÆUS' Insects and Worms that have no heart at all, is in fact at least as great as the number of those in which it is present. The so-called Zoophytes, and the Intestinal Worms, have no heart: in many animals vessels are already present before a heart can be found: insects which undergo metamorphosis have only a doubtful rudiment of a heart (the so-called dorsal vessel). The physiological importance of the heart is consequently not of that kind that it should be considered indispensable in the animal economy, as appears to be tacitly assumed in this arrangement. Moreover, in Amphibia the heart is provided not with one auricle only, but with two, and many of the Worms have not merely a ventricle, but also an auricle. Still the first four classes are so truly characterised and so firmly founded in nature, that we may well wonder that they were not in all times recognised, and not earlier formed. That clear and accurate insight which charms every one, and that simplicity to which all flatter themselves they can attain in their own province, are the true characteristics of genius. LINNÆUS was less happy in his two last classes, as we will shew more particularly. Moreover, it is not commendable that the division is founded upon a single organ or system of organs, as, for instance, those of circulation. In this way, indeed, artificial divisions may be obtained, but not a natural method. (See above, p. 29.)

The arrangement of LINNÆUS, in these last times, has undergone various alterations, when men began, after the example of CAMPER, PALLAS, POLI, and others, to investigate the internal structure of animals: in which investigation CUVIER[1], the first anatomist of our age, by his incomparable achievements was especially

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at Leyden in large folio in 1735: it consists of three tables, each containing one of the three kingdoms of nature with some notices appended. He begins with the Mineral Kingdom and ends with the Animal Kingdom.

[1] GEORGE LEOPOLD CHRÉTIEN FREDERIC DAGOBERT CUVIER, b. at Montbéliard 24 Aug. 1769, d. at Paris 13 May 1832. See my biography of this celebrated contemporary in the *Bijdragen tot de Natuurkundige Wetenschappen, vitgegeven door* H. C. VAN HALL, W. VROLICK, en G. J. MULDER. VII: 1832. p. 298—333. Very important for the history of CUVIER'S education are the letters addressed by him to C. H. PFAFF, the friend of his youth, lately published at Kiel by Professor BEHN.

distinguished. CUVIER and LAMARCK at first divided animals into two large primary classes: those which have an internal skeleton, and those without a skeleton. They called the first, in as much as the principal part of the skeleton is the vertebral column (see above, p. 24), *Vertebrate animals*, the last *Invertebrate animals* (*Animaux vertébrés et animaux sans vertèbres*). Vertebrates have moreover red blood, whilst the division of Invertebrates have either no blood or blood that is white. This fact was known to ARISTOTLE, who ascribed a spine to all animals that have blood[1]. Having made these great divisions, they adopted four classes of vertebrate animals, the same as those already established by LINNÆUS, except that they called his amphibia *Reptiles*, or creeping animals, a worse appellation. But the number of classes of invertebrate animals has so greatly increased that instead of the two classes, Insects and Worms, first five[2], and afterwards by LAMARCK[3], twelve classes, were adopted.

It would carry us too far away to discuss particularly all these divisions, and the modifications which were introduced into them. It is sufficient for our purpose to remark, that attention was now no longer directed to one organ, or one system of organs, but to the whole organisation. We propose to follow in our work CUVIER'S last arrangement with some modifications, but in a reversed order: whilst he descends from man to the less perfect animals, we, after the example of LAMARCK and others, will begin with the least perfect animals, and ascending gradually to the more composite, will conclude with man. This course is the most advantageous for Physiology. If we would understand the physiological value of an organ, we must investigate its gradual development.

CUVIER, in his latest works, has followed a general division of the animal kingdom, which takes the place of the two great primary classes of *Vertebrate* and *Invertebrate* animals[4]. He per-

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[1] Πάντα τὰ ζῶα, ὅσα ἔναιμά ἐστιν, ἔχει ῥάχιν ἢ ὀστῶδη, ἢ ἀκανθῶδη. *Hist. Anim.* Lib. III. cap. 7.

[2] See G. CUVIER, *Tableau élémentaire de l'Histoire naturelle des Animaux.* 8vo. Paris, an. 6 (1793).

[3] DE LAMARCK, *Hist. Nat. des Animaux sans vertébres.* 8vo. VII. Tom. Paris, 1815—1822.

[4] *Sur un nouveau rapprochment à établir les classes qui composent le Règne animal;*

ceived that the invertebrate division had only negative characters: these animals so greatly differ amongst themselves, that in order to say any thing precise of their organisation, they must be spoken of specially as Soft Animals, Insects, or Zoophytes. He adopted, therefore, in the place of the division of invertebrate animals three others, and thus divided the whole animal kingdom into four large groups, whose characters we here subjoin.

I. *Vertebrate Animals* (*Animalia vertebrata*). The central parts of the nervous system, the spinal cord and the brain, in these animals lie on the dorsal surface, in a bony or cartilaginous cavity formed by the vertebral column, of which the more developed anterior portion is called the skull. The limbs, when present, are never more than four in number. The muscles cover the bones, and are inserted into them. The mouth has two jaws placed horizontally.

II. *Molluscs* (*Animalia mollusca*). The central parts of the nervous system consist of ganglia, of which usually one, that from which the nerves of sense arise, lies above the œsophagus, whilst the rest are differently distributed on the abdominal surface. This nervous system lies in the same cavity with the viscera, enclosed by the soft skin into which the muscles are inserted.

III. *Articulates* (*Animalia articulata*). The central parts of the nervous system consist of ganglia, of which one lies in the head above the œsophagus: the rest in a row in the middle of the body, on the abdominal surface, and are connected by two nervous cords. The covering of the body is divided into rings, and has different degrees of hardness: the muscles are placed within these rings, and are affixed to them. When limbs or feet are present, they are usually six, frequently more: when the mouth is armed with jaws, they are placed sideways, and arranged in pairs.

IV. *Radiates* (*Animalia radiata*). A special nervous system is not always present: when found, it appears as a ring, near the mouth, surrounding the beginning of the intestine,

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Ann. du Museum XIX. 1812, p. 73–84. Afterwards in his classical work entitled, *Le Règne animal distribué d'après son organisation*, IV. vol. 8vo. Paris, 1817, (and 2nd edition V. vol. Paris, 1829, 1830).

and from this ring the nerves proceed, like rays, to the periphery of the body. The entire body presents a radiant form, for the similar parts are not arranged, as in the Articulates, behind one another in rings, but beside one another in a plane. When muscles are present, they are attached to the external, sometimes calcareous, covering of the body.

Let it not be imagined that this modification is insignificant: and that the invertebrate animals might very properly be opposed to the great division of vertebrate animals, and be afterwards split up into three sub-divisions. Such symmetrical separations are usually deceptive, and can only be of real service when the two groups are of equal rank, and are distinguished by positive characters. Beyond doubt, all natural bodies, for instance, are either *Animals* or *Non-animals:* but who, on that account, would think of separating these bodies into an *Animal Kingdom*, and a *Non-animal Kingdom?* and the *Non-animals* again into Plants and Minerals? Of like value was, in my opinion, the separation of the Animal Kingdom into Vertebrate Animals and Invertebrate Animals: the latter division meaning only "other than vertebrate animals;" it is an indefinite appendage to a defined group, and contains no general idea that can be contrasted with *another* general idea.

But what is especially to be attended to in these four great divisions of the animal kingdom is this: that they are not so much distinguished by greater or less perfection of organisation, as by general form, and by the manner in which the parts respectively are related to one another. A great variety of tissues, of organs and of subordinate parts, makes the organisation more complicated or perfect; but that must be distinguished from the general form, from the plan of the organisation. CUVIER did not overlook this truth: and even the name of *Fundamental Forms* (*Types*), which he is careful to use for these four great divisions, indicates the guiding idea which led him to adopt them. In each type there is a gradual rise and fall of organisation: we descend, says Cuvier, in the type of the Molluscs, from the *sepia* to the oyster, as in that of the vertebrates, from man to the fish. But it must not be overlooked, that CUVIER did not always sufficiently distinguish the two ideas (the *Type* and the *Perfection* of organisation), and to this it is to be ascribed that his division of *radiates* comprises many animals which

are not radiant, but are placed in this type on account of the imperfection of their organisation alone.

It is to VON BAER especially that we are indebted for a clear insight into this distinction[1]. He considers the classes as subdivisions of the fundamental form or type, which differ in respect of the higher or lower grade of organisation. We may conceive the matter differently, thus: that every animal class is determined by two factors, of which one is the *type* of organisation, the other the perfectness of structure. The highest perfectness is in general linked to the type of the vertebrates: yet how imperfect, how poor (if I may use the term) the organisation may be, even in a vertebrate animal, the anatomical investigation of *amphioxus lanceolatus* in recent times has taught us. That this little fish is in complexity of organisation far surpassed by many insects and molluscs, cannot, on unprejudiced examination, be denied.

In the arrangement, therefore, of classes, we shall lay down as our basis this idea of type of organisation, and shall thus avoid separating that which is connected by natural transitions. We begin with the Radiata, because in this type organisation stands on the lowest grade, and even the most perfectly organised radiates are surpassed by a great, nay the greatest, number of Annulates and Molluscs in complexity of organisation, variety of functions, and multifarious enjoyment of life. Whether, after these, we proceed with the Annulata or the Mollusca, is in a certain sense indifferent. Nature has not formed the creatures in a single ascending rank. Were this the case, then would a single type necessarily prevail in them all: yet even in the divisions (classes, orders and families) belonging to a single type, we are not able to discover such a simple ascent of organisation. The most perfect fish is not, by proximate affinity, joined on to the least perfect of the reptiles: nor the most composite bird to the most imperfect mammal. It was a pleasing dream of the amiable BONNET[2], that all creatures

[1] *Beiträge zur Kentniss der niedern Thiere,* von Dr. K. A. v. BAER, *Nov. Act. Cæs. L. C. Nat. Curios.* Vol. XIII. P. II. 1827. s. 523—762, especially s. 739—759; *Ueber Entwickelungsgeschichte der Thiere. Beobachtung und Reflexion.* 4°. I. Konigsberg, 1828. s. 207—219. In France also similar ideas were afterwards advanced by MILNE EDWARDS. See *ex. gr.* his remarks in the new edition of LAMARCK: *Histoire Nat. des Ani. s. vert.* I. Paris, 1835, pp. 335—337, revised by him and DESHAYES.

[2] *Contemplation de la Nature. Œuvres d'Hist. Naturelle et de Philosophie de* CH. BONNET. Tome VII. Neufchatel, 1781, 8vo. pp. 51—55, and other places.

form an unbroken chain; that without any sudden leaps, all hang together by insensible transitions. But the breaks in the chain have not been filled up by later observation, rather have new and previously unrecognised deviations from it been discovered. It is not a ladder with uniformly ascending rounds, but rather a net which may afford us a conception of the multifarious connexions and the various affinities according to which nature has arranged her products.

We have already remarked that the vertebrate animals ascend to the highest grade of perfection of organisation: of them, therefore, we may properly consider the different classes last.

In treating of the Animal Kingdom we shall not make use of CUVIER'S distribution of it into four divisions, further than as a guiding idea. The Infusories (exclusive of the Rotatories and others, which were joined to them on account of their minuteness alone) appear to form a distinct group, or at least do not indicate the radiating form by which Polyps and others of the lower animals are distinguished. We make, therefore, for these simplest animal existences a distinct Division, naming them, after the example of other authors, *Protozoa*. Their form is round or oblong, often not rigorously determined, but variable during life[1].

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[1] Five great divisions of the animal kingdom might be established, and named: *Protozoa, Actinozoa, Ectinozoa, Malacozoa, Spondylozoa*. We are too indifferent to the introduction of new names to propose these except in a note. Under *Ectinozoa* (from *ἐκτείνω, extendo*) we understand those animals in whose organisation the elongated type prevails; they nearly agree with the *Articulata*. The other names have in part been used already, and require no further explanation.

# CLASS I.

## INFUSORIES (INFUSORIA).[1]

THESE animals are called *Infusories*[2], because they are to be found in infusions of every kind of organic matter, as well vegetable as animal. Moreover they live in all stagnant marshy waters, and even in running waters, salt and fresh.

These animals, which on account of their minute size can only be discovered, or at all events examined, by means of magnifying glasses, were unknown to the ancients. Our LEEUWENHOECK first saw them in infusions towards the end of the seventeenth century (1675). After LEEUWENHOECK, many species of these animals were observed and described in the last century by ROESEL, LEDERMUELLER, VON GLEICHEN and others: but more especially O. F. MUELLER, the Danish naturalist, in a work which appeared after his death, figured many species, and gave a systematic arrangement of the class. In the present century, EHRENBERG has contributed most largely to our knowledge of infusories, and since 1828 has from time to time published his investigations in the Transactions of the Berlin Academy of Sciences, and more recently has collected them into a body in a large illustrated work.

As the discoveries of astronomers allow us to cast a glance into the illimitable extent of space of the universe, so the eye, artificially strengthened, affords conviction of the illimitable distribution of

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[1] The chief works relating to this class are:

O. F. MUELLER, *Animalcula infusoria fluviatilia et marina.* Hauniæ, 1786. 4to. The Plates are copied in the *Encyclopédie méthodique.*

C. G. EHRENBERG, *Die Infusionsthierchen, als vollkommene Organismen. Nebst einem Atlas von 64 colorirten Kupfertafeln,* Leipzig, 1838 folio. (G. VALENTIN gave in his *Repertorium für Anat. und Physiol.* IV. Bd. Jahrgang, 1839, a detailed abstract of this work, containing the characters of all the genera and species. s. 136—181.)

*Histoire naturelle des Zoophytes. Infusoires, comprenant la Physiologie et la Classification de ces Animaux,* par F. DUJARDIN, Paris, 1841. 8vo.

*Die Infusionsthiere auf ihre Entwickelungsgeschichte untersucht von* DR FRIEDRICH STEIN, mit 6 Kupfertafeln. Leipzig, 1854. 4to.

[2] First by LEDERMUELLER, according to EHRENBERG.

life in the direction of the smallest space. There are infusories (monads) having a mean diameter of $\frac{1}{1000} \ldots \frac{1}{2000}$ of a line, which yet live so closely together, that the intervening space scarcely exceeds their diameter; a single drop of water measuring a cubic line, if only one-fourth of its space were filled with such animals, would still contain 500 millions of them.

This minuteness has misled some authors to designate infusories as microscopic animals. We cannot allow to this appellation a preference to that of infusories: magnitude ought not to supply the character of a class of the animal kingdom, or a ground of division. By such an appellation, the union of diminutive species of higher classes of animals with infusories, often practised by older authors, would be justified.

In determining what is to be understood by infusories, we must look to the whole of their organisation: it requires not many words to shew that the investigation of the organisation of creatures so minute has difficulties to contend with, which even the best optical expedients of our time have only partially removed. For, although every species of infusories be not so small as to escape the naked eye, yet even these are not bigger than two or three millimeters[1]. Of the minute animals that are usually comprehended under the term infusories, EHRENBERG'S investigations led him to distinguish two classes, which he named *Polygastrica* and *Rotatoria*[2]. The incontestably greater complexity of structure in the last, the symmetry of their form and their resemblance to the type of the *Articulata*, suggested to us, as early as 1834, the propriety of separating them entirely from the others—a proceeding now approved of by almost all zoologists.

Consequently, we comprise in the class which now occupies us only those animals which EHRENBERG calls *Polygastrica*[2]. We have not, however, adopted that name, for it rests on the opinion that the cavities observable in the interior of these animals are stomachs, which is doubted by many writers: but even if that were admitted, numbers remain in which no such stomachal cavities are to be seen. The class, thus limited, contains animals of very simple

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[1] A millimeter is about half a line, or $\frac{1}{24}$ of an English inch.

[2] For the literature vid. SIEBOLD and STANNIUS, *Lehrb. der vergleich. Anatomie*, I. Abtheilung. Berlin. 1845. 8vo. s. 7.

structure. Some, in which no oral[1] aperture can be found, must receive nutriment by means of absorption through the external surface alone. Others have a mouth, usually surrounded by cilia, by the motion of which a current is produced in the water, carrying the food which it may contain to the mouth. The subsequent transmission of nutriment throughout the body is effected in spaces of a vesicular form—which contract again when their contents have been expelled: they are pushed on by others that have more lately come into view, and have motions that cannot be reconciled with the notion that they possess proper walls. We must rather suppose therefore that these vesicular spaces are excavations in the gelatinous tissue of the body. The undigested portion of the food is, in many of these creatures, cast off by another aperture[2] of the body: in others it escapes through the same opening by which it was received.

Special organs of Respiration have not been recognised. The external surface of the body appears to be the seat of that function. Still less are there any blood-vessels: perhaps those spaces, which in many species are seen to contract and expand, and which are various in form and number, may serve for moving and transmitting the nutrient fluid which supplies the place of the blood[3].

Although no muscular fibres[4] are present, these animals possess the power of motion in a great degree. Some move slowly, others very nimbly. As organs of motion the greater number have cilia. In some are produced by contraction all sorts of changes in the

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[1] [STEIN considers all ciliated infusories without a mouth to be larval or embryotic forms of other creatures. *Die Infusionsth.* s. 181.]

[2] [According to STEIN there is no ready-formed anal opening in any infusory. In those families which do not reject their excrement by the mouth, it is forcibly pressed through the integument of a determinate region of the body, more or less extensive, and not sharply defined. After the exclusion, the rupture is completely closed again. It is allowable, therefore, to speak of an anal region, not of an anal aperture. *Die Infusionsthiere.* p. 24.]

[3] EHRENBERG holds these contractile spaces, or vesicles (?), to be *vesiculæ seminales.* The *testiculus* is with him a structure whose connexion with these vesicles he has not demonstrated, and which v. SIEBOLD regards as a *nucleus*, whilst he compares the entire infusory to an organic cell.

[4] In the hollow pedicle of *Vorticella*, and other similar genera, there is a longitudinal muscle which by its contraction effects the spiral retraction of this part. EHRENB. *Die Infusionsth.* s. 270. [CZERMACK denies that the contractile streak in the canal of the stem is a muscle: see SIEBOLD and KÖLLIKER'S *Zeitschrift für wissenschaftliche Zoologie*, IV. 442. Also see STEIN, *op. cit.* p. 81.]

form of the body and of the short digitiform elongations, by means of which they move: others again have filiform, branching appendages, that can be drawn in and out. There is no doubt that these motions are to be ascribed to an internal power: they have altogether the character of volition, for the creatures sometimes retard their motions, or suddenly stop and again as suddenly swim quickly away. Infusories make no distinction of day and night: they are incessantly in motion, and no indication of sleep can be detected[1].

Coloured (red) spots have been supposed to be eyes, without any particular proof: but neither a nervous system nor any distinct organ of sense is to be found.

The multiplication of these animals is by spontaneous fission of the body, generally in the direction of the length. In this way they can increase incredibly in a short time. In a very few multiplication by buds has also been observed[2].

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[1] EHRENBERG, *Die Infusionsthierchen*, s. 529.

[2] *Ex. gr.* in *Vorticella* (early observed by SPALLANZANI), see EHRENB. *op. cit.* Tab. XXV. fig. III. 2; in *Epistylis*, &c.

[Besides the multiplication of infusories by longitudinal and transverse fission, and that by external germs, other modes have been brought to light by the labours of COHN and STEIN. They are forms of the *encysting-process*, which STEIN sees reason to believe to be common to all true infusories. *Colpoda cucullus* does not undergo fission, but becomes enclosed in a cyst, which in all cases is the secretion of the animal's surface. Within this it multiplies by successive division, so that a progeny usually four in number, occasionally eight, arises. Each of these is a special cyst, with its own external membrane. The original cyst bursts, and the special cysts repeat the same process, often several times, until at length the content of each special cyst escapes through the ruptured external membrane as young *Colpodæ*. STEIN, *op. cit.* pp. 15—25. Tab. III. fig. 1—31.

In *Vorticellines* (besides the generation by buds or germs, and by longitudinal fission), the animal, becoming encysted, is changed into a spherical mass, in which none of the original organs can be perceived except the ribbon-shaped nucleus, and a clear space, which, however, does not pulsate. Processes are sent through the thin covering at the upper exremity, and the form becomes some one of EHRENBERG'S *Acinetæ*, according to the different genera, as *Podophrya* or *Actinophrys*. The nucleus, or rather part of it, is then transformed into an internal embryo that rotates actively, and closely resembles the germ-progeny of a young Vorticelline of the same species. This process is frequently repeated in the same Acineta. The progeny may either encyst itself anew, and go through the same process, or may at once secrete a pedicle, and become an ordinary Vorticelline of the species.

Such is the process in a young Vorticelline. In a full-grown large one it is different. Here the encysted body is transformed into a homogeneous mass, the nucleus falls down into a number (more than thirty) of disci-form bodies, which derive nutriment from a portion of the liquefied substance of the mother-cyst: another portion of the maternal

If these animals are not propagated by means of eggs, then neither can they have come into being from eggs, and the general law that all that lives proceeds from an egg (*omne vivum ex ovo*) does not apply in this case: a wider meaning, then, than the ordinary one, must be given to the word egg, which denotes a part that requires impregnation before it can be developed, and contains a yolk with a germ-vesicle surrounded by an external covering. To explain the origin of these creatures in infusions, if equivocal generation be denied, nothing remains but to suppose that the air conveys infusories as it does minute particles of dust, and that the organic matter, which served for the infusion, favoured merely as an abundant nutriment the multiplication of the creatures[1]. The advocates of equivocal generation have not been able to deny the possibility of this explanation: and that possibility destroys the force of all their proofs and argumentations: especially when it is remembered that no space can be so perfectly closed that air cannot penetrate it, and that even boiling does not destroy every kind of infusory: for their opponents themselves could not absolutely deny that infusories were found in boiled infusions which were stopped[2]. Indeed the constancy of form in the species, which had been overlooked by earlier observers in their experiments, or not understood, is irreconcileable with the view that these animal forms are produced by external forces as a mere sport of chance: but it is not by any

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substance assumes a gelatinous form in which the embryos swim, and by which they are surrounded when the cyst is burst. When this substance has been dissolved in the surrounding water they swim freely away, and change the monad form for the vorticelline. STEIN, *op. cit.* pp. 50—64 and p. 146. Tab. III. fig. 32—41. Also vid. COHN, *Zeitschrift für Wiss. Zool.* III. s. 260—279. Tab. VII. fig. 1—12.]

[1] [It is well known that Infusories are conveyed by the air: EHRENBERG found them in the dust borne by the trade-wind: STEIN discovered cysts of *Colpoda*, of *Philodina roseola*, and of *Macrobiotus Hufelandii*, on the terminal twigs of beech-trees that grew 2000 feet above the level of the sea. *Philodina roseola* is the rotifer which gives the red colour to snow. Vid. STEIN, *op. cit.* p. 25. He quotes RACHENHORST'S assertion that if a slip of glass be moistened by the breath, and moved about in the confined space of an apartment, infusories may be seen upon it. SCHMIDT'S *Jahr-bücher*, 1850, Bd. LXVIII. s. 383.]

[2] [The experiments of SCHWANN, POGGENDORFF'S *Annalen*, Bd. XLI. s. 184, and of HELMHOLTZ, MUELLER'S *Archiv*, 1843, s. 453, have satisfactorily shown that an infusion boiled so long as to kill any germs previously existing in it, is never visited by infusories if only such atmospheric air be allowed access as has passed through a red-hot tube, or sulphuric acid, or caustic potass.]

means necessary to connect such a conception as this with the term *equivocal generation*. As long as it is not pretended by this term to afford an explanation, but only to indicate that there are some animal and vegetable species that arise not from eggs, but, *in a way that we are unable to explain*, from the decomposition of organic matter, so long do we believe that the expression cannot at present be dispensed with in Physiology[1]. The formation of Infusories is no primary production of organic matter[2]. Their immediate origin from the organic matter of Infusions has never, as we believe, been observed at the very instant of its occurrence, and probably never will be. Even in the development from the egg we never see the forming, but only the thing already formed. In the case of the intestinal worms[3] the same obscurity recurs, and the difficulty of applying the proposition that all living creatures come from eggs is but too obvious from the very constrained and improbable explanations which have been resorted to. The reason why organisable matter assumes those determinate forms that are distinguished as genera and species, is altogether unknown: and Physiology is, in the same degree, unable to explain how it is that in a complexly organised creature developed from cells, in one part muscular fibre should arise, in another nerves, and cartilage in another.

The knowledge which we possess of the geographical distribution of Infusories is due to the investigations of EHRENBERG. His travels in *Asia* and in *Africa* have taught us that in different countries different species, nay different genera of these animals are found. The species which have the widest geographical distribution in the northern hemisphere are *Monas termo*, *Uvella glaucoma*,

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[1] Vide note 2, page 40.

[2] "*Es giebt keine Erfahrung, die für eine Entstehung lebender Körper aus Stoffen der leblosen Natur spräche.*" G. R. TREVIRANUS, *Biologie*, II. s. 266. In this work may be found a full account of the earlier observations on this subject, to which the author has added many investigations of his own, s. 264—353. Although more than forty years have since elapsed, the labours of TREVIRANUS on this point still retain a great value. As to the green matter of PRIESTLEY, in which transformations of infusories are supposed to occur, this is not exclusively of a vegetable nature, but consists, according to the exact investigations of later enquirers, of a collection of dead, and in part still living *Infusories*, *Chlamidomas pulvisculus* (EHRENB. L. I. p. 64), *Euglena viridis* (EHRENB. p. 110), &c.

[3] [The presence of *Entozoa* in situations where it was thought impossible they could be introduced from without is now explained: *vid.* notes on that class.]

*Paramœcium chrysalis, Colpoda cucullus:* the last appears to occur everywhere (*Cosmopolite*). EHRENBERG found *Monas termo* both in stagnant water at the Red Sea, and in spring-water on Mount *Sinai*. *Colpoda cucullus* is one of the most constant animals in artificial Infusions, and was formerly observed by LEEUWENHOECK in Infusions of pepper.

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# APPENDIX

## TO THE CLASS OF INFUSORIES.

### ON (THE SO-CALLED) SEMINAL ANIMALCULES.

*(Spermatozoa.)*

VON BAER first (1827) introduced the name *Spermatozoa* (*Nov. Act. Acad. Cæs. Leop. Car.* Vol. XIII): earlier names, as *animalia spermatica, Cercaria seminis*, &c. have merely an historical value.

The bodies, for the most part filiform, which have been observed in the fecundating fluid of animals of almost every class, have as microscopic creatures been ranked with Infusories: other writers class them with the *Entozoa*, a proceeding which can only be justified in a degree by the locality where they occur; while, on the other hand, it has introduced several wrong views. An independent organisation, in virtue of which they might be considered as *real animals*, has not been discovered. The cause of their motion is altogether enigmatical.

LEEUWENHOECK, the discoverer of the Infusories, was the first also who made observations upon these small corpuscles that in appearance perform voluntary motion in male spermatic fluid. Their discovery is due to a medical student, named HAM, who announced them to LEEUWENHOECK in August, 1677 (*Phil. Trans.* 1678, No. 142; comp. Letter 113 in the *Sevende Verfolg der Brieven*, 1702, p. 65..., or in the Latin edition, *Continuatio Arcanorum Naturæ, Operum Tomo* III. p. 60 sqq.). LEEUWENHOECK named these bodies animals, and observed them consecutively in different

species of various classes of animals. It was his opinion that they formed the embryo, and that the female's share in the work of propagation was simply the reception and nutrition of the male product. This view of LEEUWENHOECK's as to the office of spermatozoa in propagation was afterwards entirely rejected: until, in our own century, DUMAS maintained that they form in animals the foundation of the nervous system (the brain and spinal cord): to which view he was led by a certain resemblance of the first rudiment of the *embryo* (the so-called primitive streak) to a *spermatozoon* (*Dict. Classique d'Histoire naturelle*, T. VII. 1825. p. 221, article *Génération*, *Annales des Sc. nat.* XII. 1827. p. 443–454). But it is not founded on observation, and is moreover sufficiently refuted by the fact that some animals have spermatozoa closely resembling those of mammals, whilst their nervous system has a totally different form from theirs.

According to WAGNER's investigations, these active molecules are formed in cells, singly or in bundles: from which, on bursting of the cell-wall, they are set free. In insects they are found as fine threads without a head, or thicker portion: but in most other creatures they consist of a thicker part, the head, and a very fine thread, or tail. The head is, in different animals, of a different shape.

[The spermatozoon of the *Batrachia* has an extremely fine membrane attached to its tail in the direction of its axis and throughout its whole length by one of the sides, the other being free and wavy. Thus a delicate undulating border is formed. It was discovered by AMICI and rightly described by him, and afterwards by POULET. By others it was mistaken for a thread surrounding the tail with a loose spiral coil. Vid. J. N. CZERMAK, *Zeitsch. f. wissensch. zool.* B. II. 350–355, also VON SIEBOLD, *ibid.* pp. 356–364.]

The different memoirs and treatises upon this subject with whose history, as EHRENBERG says, whole volumes might be filled, are not noticed by us that we may not incur a diffuseness unsuitable to the limits of this manual. R. WAGNER'S *Lehrbuch der speziellen Zoologie*, 2^te^ Auflage, Leipsig, 1843, 8vo, s. 10—30 may be consulted with advantage. It gives a full account of the most important discoveries of the author and of other contemporary observers. [This work has been translated into English by Dr Willis. Comp. the later work of R. WAGNER and R. LEUCKART, Aricle *Semen* in TODD'S *Cyclop. of Anat. and Physiol.* Vol. IV. p. 849.]

# SYSTEMATIC

# ARRANGEMENT OF INFUSORIES.

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## CLASS I.

### INFUSORIA.

MICROSCOPIC animalcules, often of mutable form, without nervous system and vessels, mostly with internal globose cavities, moving by means of vibratile cilia, or exsertile processes, without true articulated feet.

From a definition all that is uncertain and hypothetical must be excluded as far as possible. Hence we do not call the internal cavities, which are seen in most Infusories, stomachs. Our class, limited as above, contains several of the *Polypes gelatinaux* of CUVIER, and agrees with the *Polygastrica* of EHRENBERG. Many genera, as *Bacillaria*, *Navicula*, *Closterium*, are omitted, because it is highly probable that they belong, as many writers have admitted, to the vegetable kingdom.

### ORDER I. *Simplicissima.*

Naked, extremely minute, external organs none, form persistent.

Family I. *Vibrionidæ.* Body filiform.

*Vibrio* MUELL. (exclusive of many species.) Genera: *Bacterium*, *Vibrio*, *Spirillum* EHRENB.

Sp. *Vibrio lineola* MUELL., EHRENB. (and *Monas termo* MUELL. ?) MUELLER, *Infus.* Tab. VI. fig. 1; EHRENBERG, *Infusionsthierchen.* Tab. V. fig. 4; in different infusions, &c.

### ORDER II. *Rhizopoda* DUJARD. (*Pseudopoda* EHRENB. in part).

Animalcules with mutable form, moving by means of multiform exsertile processes, without vibratile cilia or other external organs.

Family II. *Amœbœa.* Animalcules naked, emitting and retracting irregular, mutable lobes by continuous motion.

*Amœba* EHRENB. (*Proteus* MUELL.)

Sp. *Amœba diffluens* EHRENB., *Volvox Chaos* L., *Proteus diffluens* MUELL.; ROESEL, *Ins.* III. Tab. CI. fig. A—T;[1] MUELL., *Infus.* Tab. II. fig. 1...12; EHRENB., *Infusionsth.* Tab. VIII. fig. xii. A gelatinous mass, of rounded form, if the entire animal contracts itself on disturbance of the water; when the water becomes quite at rest the body extends itself variously into lobes and processes, which are drawn in again. ROESEL observed these parts to be even torn asunder by extension, so that there arose two animals (Propagation by spontaneous division). The name *Proteus* had been previously given (by LAURENTI) to a genus of Reptiles, and was on that account changed into *Amiba*[2] by BORY, and into *Amœba* by EHRENBERG. [Perhaps *Amœba* is a temporary state of other forms, as of the shelled Rhizopods, &c. Vid. LIEBERKUEHN, in MUELLER'S *Archiv.* 1854, s. 17, and COHN in SIEBOLD and KOELLIKER'S, *Zeitsch f. Wissenschaft. Zool.* Bd. IV. s. 262.]

Family III. *Arcellina.* Animalcules enclosed in a membranous lorica or calcareous test, partly exsertile from their covering, and emitting processes sometimes filiform and branched.

They are small calcareous forms (shells) divided into cells, found in sea-sand and in a fossil state in the Chalk-formation, and especially in the coarse tertiary limestone. These miscroscopic creatures occur in incredible numbers, 6000 of them having been counted in an ounce of sand from the Adriatic sea, whilst an ounce from the shore of the Antilles contains, by computation, near four millions. They were investigated at the end of the last century by SOLDANI, and in the present by FICHTEL and MOLL, and afterwards especially by D'ORBIGNY, who defined more than 1600 species of them. Until within a few years these bodies were referred to the Molluscous Division, genus *Nautilus* L. (*Cephalopoda*, vid. the first edition of this Manual, II. pp. 107, 108). Recent observations, however, consign these *Polythalamia* or *Cellulacea* to a much lower position, near the genus *Proteus* of *Mueller*. Although D'ORBIGNY has been satisfied by the investigations of DUJARDIN that these animals do not belong to the Molluscs, he still believes that they ought to be considered as a distinct class of the animal kingdom (standing between the Polyps and Echinoderms), and calls them *Foraminifera*, the same name under which he formerly

[1] BORY DE ST VINCENT and DUJARDIN refer these figures to another species, supposed to differ from *Proteus diffluens* by its greater size.

[2] *Dictionn. class. d'Hist. natur.* I. 1822. p. 261.

described them as Molluscs. From the end of the last cell of the shell by one or more openings, or from numerous pores on the surface of the shell, thin contractile threads are extended which serve for motion. [On dissolving the calcareous matter from the shell of living species, there always remains an organic base of the exact form of the shell with all its pores and passages. This is a secretion effected by the contained animal mass. SCHULTZE[1].] EHRENBERG thinks that these animals are allied to the *Bryozoa* (the so-called Polyps of *Flustra*, &c.); his principal reasons against their arrangement in the class of the Infusories are, that they have no polygastric intestinal canal, and that there is no other instance of calcareous shells amongst Infusories.

On this division compare, amongst other works; D'ORBIGNY, *Tableau methodique de la Classe des Cephalopodes, Ann. des Sc. nat. première Série.* Tom. VII. 1826. p. 245—315. Pl. 10—17.

DUJARDIN, *Observations nouvelles sur les Céphalopodes microscopiques. Ann. des Sci. nat., seconde Série.* Tom. III. 1835. *Zoologie*, p. 108, 109; and *Recherches sur les Organismes inférieurs.* I. *Sur la Gromia oviformis et sur les Rhizopodes en général.* ibid. Tom. IV. Zoologie, p. 343—352. Pl. 9.

EHRENBERG, *Ueber die Bildung der Kreidefelsen u. des Kreidemergels durch unsichtbare Organismen. Abhandl. der königlich. Akademie der Wissensch. zu Berlin. Aus dem Jahre* 1838. s. 59—147. Also, *Ueber noch sehr zahlreich lebende Thierarten der Kreidebildung und den Organismus der Polythalamien*, &c. *Aus dem Jahre* 1839. s. 81—174, especially s. 106—110.

A. D'ORBIGNY, Article *Foraminifères, Dictionnaire universel d'Hist. nat. par* CH. D'ORBIGNY, Tom. V. 1845, p. 662—671.

CLARK, *On recent Foraminifera, Ann. of Nat. Hist.* Sec. Series, 1850. Vol. V. p. 161—171.

CARPENTER, *Microscopic Structure of Nummulina*, &c. *Journal of the Geol. Soc. of London*, 1850.

WILLIAMSON, *On the minute structure of calcareous shells*, &c. *Trans. Microsc. Society of London*, Vol. III. 1851, and *Quarterly Journ. of Microsc. Science*, 1853, No. IV. p. 87.

EHRENBERG, *Das wirken des unsichtbaren kleinen Lebens auf der Erde*, 1854, Tab. XIX—XXXII. Leipsig, 1854.

MAX. SIGMUND SCHULTZE, *Ueber den Organismus der Polythal.* &c. *mit 7 illuminirten Tafeln*, fol. Leipzig, 1854.

On *Noctiluca miliaris*, which appears to belong to this division, though it does not emit expansions externally but has a moveable appendage attached, see QUATREFAGES *Ann. des sc. nat. sec. Série Zool.* XIV. p. 226—235 Pl. 5, KROHN in *Archiv f. Naturgesch.* 1852 s. 77—81, Taf. 3, fig. 2. It is a chief cause of the phosphorescence in sea-water.

To this family belong also some fresh-water species.

[1] SCHULTZE, *op. cit.* p. 7.

A. *Body simple* (*Monostegia* D'ORB.)

* *Lorica membranous or horny.*

*Arcella* EHRENB. Lorica scutellate, globose, or hemispherical, sometimes angulate, open beneath: the animal emitting processes variable, plane, obtuse, through the aperture.

These animals live in fresh water. See Figures in EHRENBERG's *Infusionsthierchen*, Tab. IX. fig. V—VIII; DUJARD, *Infus.* Pl. II. fig. 3—5.

*Difflugia* LECLERC. Lorica globose or oval (sometimes subspiral?), emitting from the terminal aperture processes of the animal variable, multifidous.

LECLERC first discovered these forms (1815); see *Note sur la Difflugie, Mém. du Muséum*, II. p. 474—478, Pl. 17. sp. *Diffl. proteiformis*, fig. 2. 3; EHRENB. *Infusionsth.* Tab. IX. fig. 1. The shell, according to LECLERC, is spiral, what later observers did not perceive; it is covered with minute grains of sand.—*Diffl. globulosa* DUJARDIN, *Ann. des Sc. nat.*, 2e *Série.* Tom. VII. 1837. *Zoologie*, p. 310, 312. Pl. IX. fig. 1.

*Gromia* DUJARD. Lorica globose, membranous, emitting processes of the animal variable, slender, of great length, from a round aperture.

Sp. *Gromia oviformis* DUJARD. *Ann. des Sc. nat.* 2e *Serie*, Tom. IV. *Zoologie*, Pl. IX. fig. 1. 2, in salt water, amongst marine plants;—*Gromia fluviatilis* DUJARD. ibid. Tom. VIII. *Zoologie* Pl. 9. fig. 2;—*Grom. oviformis* DUJ. SCHULTZE, *op. cit.* Tab. I. fig. 1.

** Test calcareous.

Genera: *Orbulina, Oolina* and *Amphorina*, D'ORB.[1]

B. *Body composed of several segments. Test calcareous, divided by septa into cells.*

* *Cells simple, arranged on an axis, straight, or slightly curved.*

(*Stichostegia*).

Genera: *Nodosaria* LAM. (Sp. *Nodosaria lamellosa* D'ORB.) *Ann. des Sc. nat.* 1826, Tom. VII. Tab. X. fig. 4–6.—*Glandulina* D'ORB. (Sp. *Glandul. lævigata* ib. fig. 1–3), *Orthocerina, Dentalina* D'ORB., *Frondicularia* DEFR., *Lingulina, Rimulina, Vaginulina, Marginulina, Conulina, Pavonina, Webbina* D'ORB.

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[1] Since these small bodies are separated by D'ORBIGNY according to characters especially derived from the shell, we have thought it sufficient, for the sake of brevity, to indicate the names of the genera.

** *Cells simple, arranged in a spiral*

(*Helicostegia*).

Genera: *Cristellaria* Lam., *Flabellina*, *Robulina* D'Orb. (Sp. *Robulina orbicularis* D'Orb. l. l. Tab. xv. fig. 8, 9), *Fusulina* Fischer, *Nonionina*, *Nummulina* D'Orb. (*Nummulites* and *Lenticulites* Lam.[1]), *Assilina*, *Siderolina*, *Hauerina*, *Operculina* (Sp. *Opercul. complanata* D'Orb. l. l. Tab. xiv. fig. 7–10), *Vertebralina* D'Orb., *Polystomella* Lam. [Sp. *Polyst. strigillata* D'Orb. Schultze *op. cit.* Tab. iv. fig. 1], *Peneroplis* Lam., *Dendritina* D'Orb. (Sp. *Dendr. arbuscula* D'Orb. l. l. Tab. xv. fig. 6, 7), *Spirolina* Lam., *Cyclolina* D'Orb., *Lituola* Lam., *Orbiculina* Lam. (Sp. *Orbic. numismalis* D'Orb. l. l. Tab. xvii. fig. 8–10), *Alveolina* D'Orb. (Sp. *Alveol. Quoii* D'Orb. l. l. Tab. xvii. fig. 11–13), *Rotalina* [Sp. *Rotal. veneta*, *R. Freyeri* Schultze *op. cit.* Tab. iii. fig. 1–7], *Globigerina*, *Planorbulina*, *Truncatulina*, *Anomalina* D'Orb. (Sp. *Anom. punctulata* D'Orb. l. l. Pl. xv. fig. 1), *Rosalina* D'Orb. (Sp. *Rosal. globularis* D'Orb. l. l. Pl. xiii. fig. 1–4), *Valvulina*, *Verneulina*, *Bulimina*, *Uvigerina* D'Orb. (Sp. *Uvig. pygmæa* D'Orb. l. l. Tab. xii. fig. 8, 9), *Pyrulina*, *Faujasina*, *Candeina*, *Chrysalidina*, *Clavulina* D'Orb. (Sp. *Clavul. angularis* D'Orb. l. l. Pl. xii. fig. 7), *Gaydryna* D'Orb.

*** *Cells alternating disposed on two axes, and arranged in a spire*

(*Entomostegia*).

Genera: *Robertina*, *Asterigerina*, *Amphistegina*, *Heterostegina*, *Cassidulina* D'Orb. (Sp. *Cassidul. lævigata* D'Orb. l. l. Tab. xv. fig. 4, 5).

**** *Cells alternating, disposed in two or three rows, not forming a spire*

(*Enallostegia*).

Genera: *Dimorphina*, *Guttulina*, *Polymorphina*, *Virgulina*, *Bigenerina* D'Orb. (Sp. *Bigen. nodosaria* D'Orb. l. l. Tab. xi. fig. 9—12), *Gemmulina* D'Orb., *Textularia* Defrance (Sp. *Textul. aciculata* D'Orb. l. l. Tab. xi. fig. 1—4), *Vulvulina* D'Orb. (Sp. *Vulvul. capreolus* D'Orb. l. l. Tab. xi. fig. 5—8), *Bolivina*, *Sagria*, *Cuneolina*, D'Orb.

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[1] *Phacites*, *Lenticulites* or *Lentil-stones*. These petrifactions are found in some localities in such great abundance as to form extensive deposits affording good building-stones. In Egypt many monuments are constructed of them. Confer Blumenbach, *Abbildungen naturhist. Gegenstände*. No. 40. According to Deshayes there is found in most of the stone of which Paris is built as much of *Miliola* (vid. p. 46) as of sand-grains—and it may be said, without exaggeration, that Paris is built of *Miliolæ*. Ehrenberg, *Abhandl. der Akad. zu Berlin*, 1838, p. 65.

***** *Cells simple, clustered round an axis, each making half a spire (Agathistegia).*

Genera: *Uniloculina, Biloculina* D'ORB. (Sp. *Bilocul. Bulloides* D'ORB. l. l. Tab. XVI. fig. 1—3), *Fabularia* DEFRANCE (Sp. *Fabul. discolithes* D'ORB. l. l. Tab. XVII. Fig. 14–17), *Spiroloculina, Triloculina* D'ORB. (Sp. *Triloc. trigonula* D'ORB. l. l. Tab. XVI. fig. 5–9), *Cruciloculina, Artiloculina, Sphæroidina, Quinqueloculina* D'ORB. (Sp. *Quinqueloc. saxorum* D'ORB. l. l. Tab. XVI. fig. 10–14), *Adelosina* D'ORB.

The last division coincides for the most part with the genus *Miliola* LAM. DUJARDIN has described and figured a living species of this genus with its capillary processes or extensions under the name of *Miliola vulgaris; Infus.* Pl. I. fig. 14.

## ORDER III. *Atricha.*

Animalcules without a distinct mouth, furnished with one or more flagelliform filaments for motion, form persistent or mutable.

Family IV. *Monadina.* Body not loricated, gelatinous, pellucid.

*Monas* MUELL. (exclusive of several species). Body oblong or round, with a single flagelliform filament.

See figures in EHRENB. *Infus.* Tab. I. To this genus belong animalcules of $\frac{1}{1000}$ line, in which the highest magnifying power shews no organisation, and which even at the present day, with the assistance of the best microscopes, cannot be otherwise characterised than as punctiform bodies—the character given by MUELLER to his genus *Monas.*

*Uvella* BORY, EHRENB. [Monadines associated in clusters in form of a mulberry or of grapes revolving in all directions.]

*Cercomonas* DUJARD., *Bodo* EHRENB. (in part). Body caudate.

Family V. *Cryptomonadina.* Body loricated, with a membranous flexible test.

*Cryptomonas* EHRENB. (*Cryptoglena* ejusd., with an eye-point).

Family VI. *Volvocina.* Several animalcules contained in a common envelope, or furnished each with its own envelope, which is confluent into one mass.

*Pandorina* BORY (in part), EHRENB. Animal without eye-point and tail, furnished with a vibrating flagellum, a simple urceolate lorica, by spontaneous internal division resembling a mulberry.

Sp. *Pandorina morum, Volvox morum* MUELL. *Infus.* Tab. III. fig. 14—16, EHRENB., *Infusionsth.* Tab. II. fig. 33.

*Gonium* MUELL. Animals without eye-point and tail, by spontaneous division conjoined in a common quadrangular flat envelope.

Sp. *Gonium pectorale* MUELL. *Infus.* Tab. XVI. fig. 9—11; EHRENB. Tab. III. fig. 1.

[*Synura* EHRENB. (Tab. III. fig. 9.) an uncertain genus].

*Chlamidomonas* EHRENB. Animal with eye-point and double flagellum, without tail, included in an urceolate envelope, either simple or multiple from spontaneous division within the common covering.

Sp. *Chimidomonas pulvisculus, Monas pulvisculus* MUELL. *Infus.* Tab. I. fig. 5. 6; EHRENB. *Infusionsth.* Tab. III. fig. X: represented by authors as in part the green matter of PRIESTLEY. These animalcules were long ago observed by LEEUWENHOECK; see *Sevende vervolg der Brieven*, 1702. No. 142, p. 402.

*Volvox* L. (exclusive of several species) Animalcules with eye-point and single or double flagellum, included in the surface of a globular envelope which rolls on its axis: there are often smaller globules (*gemmæ*) within the large one[1].

Sp. *Volvox globator* L., LEEUWENH. *Sevende vervolg der Brieven*, No. 122, p. 156, fig. 2; ROESEL, *Ins.* III. Tab. CI. fig. 1–3; MUELL. *Infus.* Tab. III. fig. 12–13; EHRENB. *Infusionsth.* Tab. IV. fig. 1. DUJARDIN, *Inf.* Pl. IV. fig. 30. *Globe-animalcule;* a small green globule, as much as $\frac{1}{4}$ line in size, and hence visible to the naked eye as a fine grain of sand; in marshy water. This form was first discovered by LEEUWENHOECK. On the surface of the globule minute warty points are seen; these are the individual animalcules or monads of $\frac{1}{288}$ line. Within the globule smaller globules are developed, which occasionally rotate within the large one until it bursts and dies away[2].

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[1] [See F. COHN'S paper in SIEBOLD and KOELLIKER'S *Zeitschrift für wissenschaftliche Zoologie*, Band IV. p. 77, &c. for reasons why the *Volvocina* ought perhaps, as Von SIEBOLD and others believe, to be classed amongst *Algæ*.]

[2] For an account of the development and encysting of individual monads of the colony, of a size nearly as large as that of a young colony, see STEIN'S *Infusionsthiere*, &c. pp. 45—46. When the full size has been attained the cyst thickens into regular conical processes, giving the form which Ehrenberg has described as a distinct species, *Volvox stellatus*. These large encysted volvoces are for the continuation of the species after the ordinary individuals of the colony have perished.]

Family VII. *Astasiæ*. Body not loricated, caudate or ecaudate, form mutable.

*Astasia* EHRENB. Animal free, caudate, without an eye-point.

Sp. See figures in EHRENBERG'S *Infusionsth.* Tab. VII. fig. I.–IV. DUJARDIN *Infus.* Tab. V. fig. 12.

*Euglena* EHRENB. (and *Amblyophis* ejusd.) Animal free, with an eye-point.

* Body ecaudate.

*Amblyophis* EHRENB.

** Body caudate.

Sp. *Euglena viridis, Cercaria viridis* MUELL. *Infus.* Tab. XIX. fig. 6–13; EHRENB. *Infusionsth.* Tab. VII. fig. IX; DUJARD. *Infus.* Pl. V. fig. 9, 10.

This species also belongs to PRIESTLEY'S green matter; another species can occasionally by its red colour give to water a blood-red appearance.

Family VIII. *Periphrygana* (*Enchelia* EHRENB. in part). Body orbicular, surrounded with setaceous tentacles, without vibratile cilia.

EHRENBERG ascribes an oral aperture to *Actinophrys*, which DUJARDIN could not perceive. There are no cilia, but there are appendages or *cirrhi*.

*Actinophrys* EHRENB., *Peritricha* BORY. Body rough with tentacles radiating in all directions.

Sp. *Actinophrys sol* EHRENB., *Trichoda sol* MUELL. *Infus.* Tab. XXIII. fig. 4$\frac{3}{4}$–4$\frac{5}{6}$, EHRENB. *Infusionsth.* Tab. XXXI. fig. VI. DUJARD. *Infus.* Tab. III. fig. 3. in fresh water.

Subgenus *Podophrya* EHRENB. Body with a transparent appendage resembling a pedicle.

Sp. *Podophrya cometa, Trichoda fixa* MUELL.[1]

*Trichodiscus* EHRENB. Body radiating with tentacles at the margin only.

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[1 The pedicle of *Podophrya* is very variable in length. In some of the forms it almost disappears, so as to render it difficult to determine whether an *actinophrys* or *podophrya* be under examination. STEIN thinks there is no specific difference between the two, certainly no generic. From his observations it appears, indeed, that both *Actinophrys* and *Podophrya* are *Acinetæ*—forms derived from encysted *Vorticella microstoma*. *Die Infusionsthiere*, p. 138, &c.]

## Order IV. *Epitricha.*

Animalcules moving by means of vibratile cilia.

Section I. *Astoma*[1].

Family IX. *Peridinæa.* Loricated, with a coronet, or a transverse belt of cilia.

*Peridinium* Ehrenb. (Species of *Cercaria* Muell.)

Sp. *Peridinium tripos* Ehrenb. (*Cercaria tripos* Muell., *Infus.* Tab. xix. fig. 22; Ehrenb., *Infusionsth.* Tab. xxii. fig. xviii.; the lorica terminates in three points; two anterior curved backwards, and one posterior, which is straight. The animacule attains a length of $\frac{1}{12}$ line; it is found in the Baltic.

Michaelis observed a phosphorescence in this and some other species of this genus, and thus proved, what had been suspected before, that Infusories contribute to the illumination of the sea. *Ueber das Leuchten der Ostsee*, Hamburg, 1830; comp. Ehrenberg, *Das Leuchten des Meeres. Ein in der Königl. Akademie der Wissenschaften gehaltener Vortrag.* Berlin, 1835, 4to.

To this genus also probably belong as fossil species some organic remains which Ehrenberg discovered in the chalk-formation in firestones.

*Dinophysis* Ehrenb. (*Abhandl. d. Königl. Akad. d. Wiss. zu Berlin, a. d. Jahre* 1839, s. 124.)

Section II. *Stomatoda.* (Animalcules with mouth and œsophagus leading into the parenchyme of the body. One or more round, contractile cavities, pulsating rhythmically, situated beneath the integument at the surface of the body.)

Family X. *Trichodina* (*Trachelina* and *Colpodea* Ehrenb.) Body oval, with vibratile cilia, without cirri or styli, not loricated.

*Trichoda* Muell. (in part, *Trichoda* Dujard. and *Trachelius* Schrank, Ehrenb., Dujard.) An oblique row of large cilia at the mouth.

*Phialina* Bory, Ehrenb.

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[1] I consider this description as merely provisional. As to the presence of a mouth in particular genera of Infusories much variety of opinion exists, and that the point is not easy to determine will be obvious to every one who observes for himself. This character, then, in the present state of our knowledge, scarcely deserves a prominent position. [Vid. note 1, p. 39.]

*Enchelys* MUELL. (exclusive of several species[1]), *Acomia* DUJARD., *Gastrochæta* ejusd., *Alyscum* ejusd., *Uronoma* ejusd.

*Bursaria* MUELL. (in part), DUJARD. (*Bursaria* and *Spirostomum* EHRENB. in part.) Body everywhere ciliated, often dilated posteriorly; mouth oblique surrounded by cilia arranged spirally.

Sp. *Bursaria truncatella* MUELL., *Infus.* Tab. XVII. figs. 1—4; EHRENB. *Infusionsth.* Tab. XXXIV. fig. 5.

To this division EHRENBERG refers the *Opalina Ranarum* of PURKINJE and VALENTIN, first discovered and figured by LEEUWENHOECK: *Ontledingen en Ontdekkingen* 1685, p. 13, fig. 3, A. DUJARDIN and VON SIEBOLD [and STEIN.] do not admit the presence of a mouth in this species, the first two retain the genus *Opalina*. [STEIN. suspects the *Opalina* to be larvæ of worms. The different species have very different structure. *Die Infusionsth.* s. 182—187.]

*Ophryoglena* EHRENB. Body rough with cilia disposed in longitudinal rows, ovate, with eye-point black or red.

See Fig. in EHRENB. Tab. XL. figs. 6–8.

*Spirostomum* EHRENB. in part, DUJARD.

*Glaucoma* EHRENB. Body everywhere ciliated, mouth unarmed, with a tremulous valve like a longitudinal lip.

Sp. *Glaucoma scintillans* EHRENB., *Infusionsth.* Tab. XXXVI. fig. V., DUJARD. *Infus.* Tab. VI. fig. 13.

*Chilodon* EHRENB. Body oval, with a lateral sinus forwards, cilia all over disposed in longitudinal rows, mouth inclosing a cylindrical fasciculus of little rods (*teeth*).

Sp. *Chilodon cucullulus, Kolpoda cucullulus* MUELL., EHRENB. *Infusionsth.* Tab. XXXVI. fig. VI., DUJARD. *Infus.* Tab. VI. fig. VI. [STEIN. *Infusionsth.* Tab. III. 51.]

*Nassula* EHRENB.

*Lacrymaria* EHRENB. (and *Trachelocerca* ejusd.)

Sp. *Lacrymaria olor* EHRENB., *Vibrio olor* MUELL., *Infus.* Tab. X. figs. 12–15, EHRENB. *Infusionsth.* Tab. XXXVIII. fig. VII.

*Colpoda* EHRENB. (Species from the genus *Colpoda* MUELL.) Body laterally emarginate or sinuous, reniform, with cilia disposed in rows, mouth lateral unarmed.

Sp. *Colpoda cucullus* MUELL., *Infus.* Tab. XIV. figs. 7–14, EHRENB. Tab. XXXIX. figs. V. &c.

*Paramecium* MUELL. (exclusive of species), EHRENB. (in part), DUJARD.

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[1] Nothing can be more capricious than the use by modern writers of this generic name of MUELLER. See DUJARDIN, *Hist. nat. des Infus.* pp. 385, 386.

*Amphileptus* EHRENB. (*Amphileptus* and *Loxophyllum* DUJARD.)

Sp. *Amphileptus meleagris, Kolpoda meleagris* MUELL., *Infus.* Tab. XIV. figs. 1–6, XV. figs. 1–5, EHRENB. Tab. XXXVIII. fig. 4.

Family XI. *Oxytrichina.* Body mostly plane or depressed, armed with vibratile cilia and setæ, and hooks or styles not vibratile, not loricated.

This family agrees with the genus *Kerona* of MUELLER. Besides the usual fine cilia, the animals have other organs for creeping and for the support of the body in climbing, and which are distinguished by EHRENBERG as bristles (*setæ*), styles (*styli*) and hooks (*uncini*); *Infusionsth.* s. 338.

Genera: *Kerona* MUELL. in part, DUJARD. (*Stylonychia* and *Kerona* EHRENB., *Ceratidium* ejusd.)—*Oxytricha* BORY (*Oxytricha* and *Urostyla* EHRENB.); *Halteria* DUJARD.

Sp. *Kerona mytilus* (and *Ker. haustellum*) MUELL., *Infus.* Tab. XXXIV. figs. 1–4, EHRENB. *Infusionsth.* Tab. XLI. fig. IX., DUJARD. *Infus.* Tab. XIII. figs. 2, 3; very common in fresh water, size $\frac{1}{20}$ to $\frac{1}{8}$ line. If this form be compared with monads, *Vibrios* and the animals of *Volvox globator*, it will be seen that in respect of size there is as great a difference amongst Infusories as amongst Mammalia.

Family XII. *Euplota* (*Euplota* and *Aspidiscina* EHRENB.) Body oval, depressed, loricated. Vibratile cilia around the mouth; besides cilia, often styles and hooks for motion.

*Euplotes* EHRENB. (*Phlasconia* BORY, DUJARD.) Lorica oval or suborbicular, longitudinally ribbed or striated; body with styles and hooks.

Sp. *Euplotes patella, Kerona patella* MUELL., *Infus.* Tab. XXXIII. figs. 14–18, EHRENB. *Infusionsth.* Tab. XLII. fig. IX., DUJARD. *Infus.* Tab. VIII. figs. 1–4.

*Chlamidodon* EHRENB. Styles and hooks none. Slender rigid rods arranged in a cylindrical fasciculus around the mouth (*teeth*).

Sp. *Chlamidodon mnemosyne* EHRENB., *Infusionsth.* Tab. XLII. fig. VIII; in the Baltic.

*Diophrys* DUJARD.

*Himantophorus* EHRENB.

*Aspidisca* EHRENB. Lorica produced beyond the body forwards, hyaline; longitudinal flexible setæ on the ventral side, for stepping and creeping.

Sp. *Aspidisca lynceus, Trichoda lynceus* MUELL., *Infus.* Tab. XXXII. figs. 1, 2, EHRENB. *Infusionsth.* Tab. XXXIX. fig. 1.

*Loxodes* DUJARD., not EHRENB. [young individuals of *Chilodon cucullulus* with imperfectly developed infundibulum. STEIN. *Infus.* p. 131.]

*Ervilia* DUJARD. (Species from the genus *Euplotes* EHRENB.)

*Trochilia* DUJARD.

Family XIII. *Vorticellina* (*Vorticellina* and *Ophrydina* EHRENB.) Body campanulate or infundibuliform, with large vibratile cilia at the margin of the aperture. Mouth and anus approximate, situated in a pit of the margin.

Formerly these animals were classed amongst the Polyps as *Bell-Polyps, Bastard-Polyps,* &c. (See the first Dutch edition of this *Handbook,* I. p. 66.) It was believed that the infundibular or bell-shaped body is the cæcal stomach, and the large opening the mouth. The true oral aperture, however, is placed on the edge of the hollowed body. The food describes a circle in the parenchyme (according to EHRENBERG in a special intestinal canal[1] with several lateral dilatations) and is again ejected near the oral aperture (hence the names *cyclocœla* and *anopisthia* given by EHRENBERG). The analogy with the molluscan type, even if an intestinal canal be not admitted, cannot be overlooked, and probably these animals will be ranked by future writers, as imperfect forms, with the *Bryozoa.*

The cilia on the edge of the bell-shaped body cause in the water an eddy which hurries onwards minute corpuscles whether dead or alive, and conveys them towards the cavity. If some early and also later observers (amongst others even AGARDH, *Nov. Act. Acad. Cæsar. Leop. Carol. Natur. Curiosor.* X. 1821, pp. 127—137, Tab. VII. ii.) have seen in this a power of fascination, the fact must be ascribed to the circumstance, that they did not notice the cilia.

## Phalanx I. Body not pedunculated.

### *A. Naked.*

*Stentor* OKEN, EHRENB. (Species of *Vorticella* MUELL.) Body conical, from its contractility polymorphous, everywhere

[1] See FOKKE'S observations on *Stentor,* which led him to doubt so early the existence of a special intestinal canal. OKEN'S *Isis,* 1836. s. 785, 786.

covered with small cilia, besides a coronet of larger cilia, free or temporarily sessile.

*Stentor Muelleri* EHRENB., *Hydra stentoria* L., ROESEL *Ins.* III. *Suppl.* Tab. XCIV. figs. 7, 8, MUELL. *Infus.* Tab. XLIII. figs. 6–12, EHRENB. *Infusionsth.* Tab. XXIII. fig. I, DUJARD. *Infus.* Tab. XV. fig. 1; on the under surface of *Lemna*. When swimming the animal has an oval form, and moves in serpentine and differently curved lines; when at rest or attached, it has an extended trumpet-like form.

*Urceolaria* Lam. (in part), DUJARD. (*Trichodina* EHRENB.) Body globose or urceolate, not ciliated throughout.

*Urceolaria stellina*, *Trichodina pediculus* EHRENB., *Cyclidium pediculus* MUELL. and *Vorticella stellina* and *discina* ejusd., MUELL. *Infus.* Tab. XXXVIII. figs. 3–5, EHRENB. *Infus.* Tab. XXIV. fig. IV. The animalcule creeps on fresh-water polyps and other bodies by means of moveable hooks on the dorsal surface (or on the extremity opposite to the opening)[1]: in swimming it rotates rapidly.

*Urocentrum* NITZSCH, EHRENB.

*B. Loricated,* or *contained in a gelatinous envelope.*

*Ophrydium* EHRENB. (*Ophrydia* BORY in part.) Aggregated animalcules, contained in a common gelatinous body (*infusorium ?*)[2].

Sp. *Ophrydium versatile* EHRENB., *Infus.* Tab. XXX. fig. 1. Green globular masses of ½—5 inch. in diameter, forming as it were the infusory-stock or hive of an animal which MUELLER first described and figured as *Vorticella versatilis*. Earlier and later authors have taken this Polypary for a species of plant, and have described and figured it under the name of *Ulva pruniformis*, *Fucus subglobosus*, *Coccochloris stagnina*, &c. The analogy of the Vorticellines with the *Bryozoa* and Molluscs (compound *Ascidiæ*) alluded to above, derives confirmation from this form also.

*Vaginicola* LAM. (in part) EHRENB. Animal solitary with urceolar lorica, body and lorica sessile.

Sp. *Vaginicola crystallina* EHRENB., *Infus.* Tab. XXX. fig. V., DUJARD. *Infus.* Tab. 16 bis, fig. 6; formerly observed by LEEUWENHOECK; they propagate by longitudinal fission within the transparent sheath.

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[1] [For an elaborate description see STEIN. *Die Infus.* s. 175.]

[2] [The gelatinous infusory-stock or hive is a product of secretion from the base of the body of each animalcule, and so is the homologue of the pedicels in Vorticellines. Vide STEIN. *op. cit.* p. 246.]

*Cothurnia* EHRENB. Animal solitary, sessile, with urceolar lorica, pedunculate.

(According to DUJARDIN not sufficiently distinct from the preceding genus.)

Phalanx II. Body (in the first period of life) pediculated.

*A.. Naked.*

*Vorticella* MUELL. (exclusive of several species). Animal campanulate, with a flexible pedicle spirally contractile.

These animals adhere to water-plants, water-insects, small crustacea (*Cyclops*), &c. At a certain period they part from the stem, and then, as freely moving forms, are provided with cilia near the posterior extremity by means of which they move forward, whilst the coronet of cilia at the edge of the opening is entirely retracted.

*a) with simple pedicle.*

*Vorticella* EHRENB. Sp. *Vorticella convallaria* L., *Vorticella nebulifera* EHRENB., ROESEL, *Ins.* III. *Suppl.* figs. 2, 4–7, MUELL. *Infus.* Tab. XLV. fig. 1, EHRENB. Tab. XXV. fig. 1.—A very similar species occurs in artificial infusions, which on contraction exhibits transverse rings, and which EHRENBERG distinguishes as *Vortic. convallaria.*

*b) with branching pedicle.*

*Carchesium* EHRENB. Sp. *Vorticella polypina* L., MUELL. *Infus.* Tab. XLVI. figs. 7–9; EHRENB. *Infus.* Tab. XXVI. fig. 5; *polypes à bouquet* TREMBLEY; resembles an umbelliferous shrub, of about one line in size, in fresh and also in sea-water; see BASTER, *Natuurk. Uitspanningen* I, Tab. III. fig. 1, C; SLABBER, *Natuurk. Verlustigingen* 1778. Tab. V. fig. 2.

[*Zoothamnium*[1] EHRENB.

Sp. *Zoothamnium arbuscula* EHRENB., *Infusionsth.* Tab. XXIX. fig. 2.]

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[1] The stem of spirally flexible Vorticellines consists of a wall and an internal canal containing a thread, or streak, which does not exactly fill it. When a stem or branch divides, the structure of the divided parts is not exactly the same in *Carchesium* and *Zoothamnium*. In *Carchesium* the canal and streak of a branch have no connexion with the corresponding parts of the stem on which it stands. After each fission one only of the fission-progeny occupies the apex of the already existing stem, and continues to prolong it by secretion of new matter, the canal and the thread suffering no breach of continuity. The other individual secretes at first a short portion of stem which is quite solid, and is in connexion with the outer wall only of the stem previously existing. It is after this commencement that a new canal and a new streak begin to be seen. The same occurs at every subsequent division: the individual at the apex has the canal and streak of its stem in continuity with the similar parts

*Epistylis* EHRENB. (and *Opercularia* ejusd.) The animal conical or campanulate, with rigid pedicle, simple, or branched from imperfect spontaneous division.

Sp. *Epistylis flavicans* EHRENB., *Vorticella umbellaria* LAM., ROESEL, *Ins.* III. *Suppl.* Tab. C.;—*Opercularia articulata* EHRENB., ROESEL, ib. Tab. XCVIII. figs. 5, 6, &c.

## *B. Loricated.*

*Tintinnus* EHRENB.

Sp. *Tintinnus inquilinus*, *Vaginicola inquilina* LAM.

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previously existing, whilst the other has the beginning of its stem solid, and afterwards a canal and streak not continuous with those previously existing.

In *Zoothamnium* a continuous canal runs through the stem and all the branches of the colony, and the streak also divides at every fork, so that all the streaks and canals are in connexion. STEIN. *op. cit.* pp. 82—84.]

# CLASS II.

## POLYPS. (*POLYPI*)[1].

POLYPS are gelatinous, oblong or conical animals with a contractile body, an intestinal cavity and an oral aperture, which is surrounded by a circlet of arms or tentacles.

Besides these arms there are no special organs of sense, at least in the greater number of Polyps, though all appear to be very sensible of the stimulus of light. Propagation is effected partly by eggs, partly by germs or buds: in many instances the last are not detached from the parent stem, and thus there arise compound animals, different individuals being connected.

Our Polyps were, for the most part, unknown to the ancients: and under this name entirely unknown. By it they understood naked molluscs of the form of sepia, especially that genus which is now called *Octopus*[2] by Zoologists. From analogy, and from some resemblance of form, RÉAUMUR and JUSSIEU first gave the

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[1] Of the numerous works on this class we are content to quote the following:

A. TREMBLEY, *Mémoires pour servir à l'Histoire d'une genre de Polypes d'eau douce, à bras en forme de cornes.* Leide, 1744, 4to.

J. ELLIS, *An Essay towards a Natural History of the Corallines and other Marine Productions*, &c. Lond. 1755, 4to, with plates.

J. ELLIS and D. SOLANDER, *The Natural History of many curious and uncommon Zoophytes*, with 62 plates. London, 1786, 4to.

P. S. PALLAS, *Elenchus Zoophytorum.* Hagæ Comitum, 1766.

F. CAVOLINI, *Memorie per servire alla storia de' Polipi Marini.* Napoli, 1785, 4to.

E. J. C. ESPER, *Die Pflanzenthiere in Abbildungen nach der Natur.* III. Thle. Nürnberg, 1761—1797 (with two supplements).

W. RAPP, *Ueber die Polypen im Allgemeinen und die Actinien insbesondere.* Weimar, 1829, m. 3 color. Kupfertafeln, 4to.

C. G. EHRENBERG, *Die Corallenthiere des rothen Meeres. Physikalische Abhandlungen der Königl. Akad. der Wissenschaften zu Berlin aus dem Jahre* 1832, s. 225—380. (Also published separately, Berlin, 1834, 4to.)

G. JOHNSTON, *History of British Zoophytes. Second edition, with numerous illustrations on copper and wood.* 2 vols. 8vo, 1847.

[2] The French name *Poulpe* now given to this animal is merely a corruption of the ancient name *Polypus*.

name Polyp to those fresh-water animals that had been described by TREMBLEY, and which are provided with a circlet of arms.

To this class belong many marine animals, which at first sight rather resemble plants than animals. Formerly these so-called Sea-Plants were, on account of the hardness of the calcareous substance of which they consist, referred to the mineral kingdom: and Corals were compared to branching crystallisations (*Arbor Dianæ*) and stalactites. Hence the name (*Lithophyta, Lithodendra*) stone-plants. The ancients believed that Corals were soft whilst in the sea, and only became hard in air:

> *Nunc quoque curaliis eadem natura remansit,*
> *Duritiem tacto capiant ut ab aere, quodque*
> *Vimen in æquore erat, fiat supra æquora saxum.*
>
> OVID, *Met.* IV. 750—752.

Even amongst later authors traces may be found of the same opinion, founded on defective observation, or on confusion of soft species with similar hard ones. Up to the middle of the last century, it was the prevailing view that these Corals belonged to the vegetable kingdom. MARSIGLI, in 1706, observed on the shore of the Mediterranean some of these products (*Alcyonium, Corallium, Antipathes*), and found in their pores little bodies that contracted when the stem was removed from the water. Such bodies or buds he took to be flowers, and so believed that at length the view was definitively established which consigned these marine products to the vegetable kingdom. But still the animal odour, that was observed, opposed this view, as well as the chemical investigations of GEOFFROY, of LEMERY, and of MARSIGLI himself, which demonstrated ammoniacal constituents in these supposed sea-plants, just as in animal substances. PEYSONNEL, a physician of Marseilles, observed at that place (1723) the Blood-Coral, and afterwards on the coast of Northern Africa examined different Madrepores and Millepores: the result was that he found MARSIGLI'S Plants to be Animals, and named them *Orties Corallines*. He imparted his discovery to RÉAUMUR: to whom the notion seemed so improbable, that in a short notice of it which he gave in the *Mémoires* of the Academy of Sciences at Paris 1727, he felt bound to suppress the discoverer's name. Shortly afterwards, when PEYSONNEL'S discovery had been forgotten, TREMBLEY found in our country the fresh-water Polyp, and communicated his observations to RÉAUMUR,

In the two following years BERNARD DE JUSSIEU, the celebrated Botanist, investigated *Alcyonium* (*Lobularia*), *Flustra* and *Tubularia* on the coast of Normandy, and confirmed PEYSONNEL'S discovery: whilst RÉAUMUR also adopted his views. LINNÆUS, accordingly, transferred the Corals and stone-plants to the animal kingdom: and thus more than half a century was required to effect the adoption by Science, as a firm truth, of that view which FERRANTE IMPERATO had announced at the beginning of the 16th century[1]. ELLIS, PALLAS, CAVOLINI and other authors, in the latter half of the past century, extended and multiplied our acquaintance with these interesting marine animals, of which the investigation still affords to sçavants of the present day a rich material for new and important discoveries.

Polyps are either naked, or are provided with a body more or less hard, which they surround like a bark, or by which they are surrounded. To the naked Polyps belong the well-known Armed Polyp of fresh-water (*Hydra L., Polype d'eau douce, à bras en forme de cornes*). The body of this animal is hollow within, and terminates in a little cylindrical stalk that is without any opening. There is a single row of tentacles round the mouth which can be extended like long rays, or be contracted into little conical swellings. These tentacles are not all formed at once, but at different times: their number is therefore indeterminate, and frequently varies in the same species. Generally there are not more than six tentacles present: rarely more than twelve. By their assistance the fresh-water Polyp can creep along upon water-plants or upon the bottom, overpower its prey, and convey it to the mouth. These Polyps are very voracious, and feed upon minute Crustaceans (*Cypris*, *Daphnia*, *Monoculus*, &c.), and upon worms (*Stylaria paludosa* LAM. *Naïs*, *Tubifex*, &c.), which frequently surpass them in bulk. Accordingly

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[1] To complete this compressed historical review, we refer to B. DE JUSSIEU, *Examen de quelques productions marines*, &c. *Mém. de l'Acad. royale des Sciences*, 1742. pp. 290—302; RÉAUMUR, *Mémoires pour servir à l'Histoire des Insectes*, Tom. VI. 1742. *Preface*, pp. 49—80; PALLAS, *Elench. Zoophytor.* pp. 13—20; LAMOIGNON MALESHERBES, *Observations sur l'Histoire natur. de* BUFFON *et de* DAUBENTON. Paris, 1798, II. pp. 154—206; EHRENBERG, *Die Corallenthiere des rothen Meeres*, pp. 4, 5; MILNE EDWARDS, *Ann. des Sc. Natur.* sec. Série, Tom. VI. *Zoologie*, 1836. pp. 5—9; FLOURENS, *Analyse d'un ouvrage manuscrit intitulé, Traité du Corail &c. par* DE PEYSONNEL, *Ann. des Sc. Nat.* sec. Sér. Tom. IX. *Zoologie*, 1838, pp. 334—351.

their mouth admits of much expansion: and the body can be distended. The food is moved to and fro in the cavity of the body, and in a short time (often within a quarter of an hour) is converted into a pap. The undigested residue is rejected through the mouth. Propagation is effected usually by buds. A minute swelling rises on the surface of the Polyp; it grows, loses its conical form, becomes tubular, acquires tentacles, and is then a new Polyp. The young animal continues to sit on the body of the parent, and thus receives the same nutrition in common. Upon this young one other young buds may be developed. Thus a branching arises. At length the young Polyp separates itself from the parent stem (in summer frequently after four days, in winter later), assumes an independent state, and new buds are formed, or those already present are multiplied.

Thus these Polyps may form compound animals. Many individuals of the same species are united so as to make up a single body. All the animals thus combined gain their nutrition in common,—have a common life. It is not the animal kingdom only that affords us instances of compound living bodies: the vegetable kingdom presents many such[1]. By an individual, in the vegetable and animal kingdoms, may be understood a body that cannot be divided into two or more similar portions, without the idea of a whole being lost, and whose vital functions pass through a determinate cycle of periods[2]. The development of the fruit is the final function in vegetable life: when this is accomplished the plant may die. Many plants bear fruit only once—whether in one year, or in two or more years; such plants die after fructifying, and are true individuals. There are other plants again, which leave a determinate portion after the fructification, that continues to live, and, after a time, bears fruit anew. The portion that thus remains may consist of root alone, or of root and stem. Such plants are, in reality, compound.

A tree therefore is not an individual, not a *single plant*. The buds of the tree are new plants: they are developed, grow, possess an independent life, which is passed in determinate stages. Hence

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[1] See LAMARCK, *Hist. Nat. des anim. sans vert.* I. p. 69, &c. (and 2nd edit. p. 65, &c.). *Comparaison des Animaux composés avec des végétaux pareillement composés.*

[2] See SCHLEIDEN in MUELLER'S *Archiv.* 1838. s. 168.

old trees may afford an emblem of perennial youth: every spring they are covered again with leaves as fresh as those they had fifty years before. The stem alone is old, the leaves are still young again.

We might be able, from the branching of the fresh-water Polyps from their living stem, to explain the plant-like forms of Corals and other such marine products. When a Polyp does not consist of a single soft mass, but contains a harder substance, or is surrounded by a calcareous sheath, then from the union of many such a body may arise which resists decomposition, and as such after the death of the Polyps, may be preserved in our collections for a length of time, as for ages they have been preserved in the calcareous strata of our mountains, formed at the bottom of the sea in a former epoch of the world. This common mass is named a *Polypary* or *Polypstock* (*Polyparium*)[1]. After the Polyps had been discovered, these stone-plants, as they had been called, were supposed to be the work of the animals that dwelt in them, and were compared to the cells of bees. This view of the matter does not now require confutation. That of LAMARCK and others agrees more closely with the true nature of the process; they consider the polypary to be a secretion upon the surface of the Polyps, and compare it with the shells of Molluscs (Snail or Mussel-shell). As there are Snails both naked and with shells, in like manner there are Polyps that are naked, and that are shut up in tubes: and the Polypstock is the union of the shells caused by the connexion of the Polyps that lived in them. Thus the *Polypary* would be, on this view, a dead substance, deposited in layers like a mussel-shell. Though this be nearer the truth than the earlier idea according to which the Polyps built their houses, still it does not entirely accord with the true nature of the process. Observation proves that this part, at least in many species, has a proper life, that it is nourished, grows, and is the seat of that gemmation whence new

[1] It appears that RÉAUMUR first invented this appellation, now in common use; *"Auroit-on pu prévoir. . . . que ces corps qui sembloient avoir végété dans la mer, étoient pour les polypes ce que les guépiers sont pour les guêpes; qu'on ne devoit plus leur laisser le nom de plantes et que pour leur en imposer un qui exprimât exactement ce qu'ils sont, on devoit les appeller des polypiers?" Mém. pour servir à l'Hist. des Insectes.* Tom. VI. Préface, p. 69.

Polyps have their being. It is a covering which, like a dermal skeleton[1], may become horny or calcareous.

The hard, stone-like Polypstocks which form coral-banks, are particularly deserving of notice. But the part they play in altering the earth's surface has been much exaggerated by FORSTER, PERON, and other voyagers. The numerous coral islands of the southern Pacific having an annular form with banks steep on the outside and shelving gently down to the trough or the included water, are clearly of volcanic origin. They are covered with Corals, but do not consist of Corals. Polyps cannot live at great depths, but the Corals rest on shallows or on mountain-ridges in the sea, similar to the rocks parallel to the coast of the Red Sea. Hence Corals may contribute to the formation of islands, or may prevent the washing away of the shores of islands already formed, just as plants that grow on sandy coasts protect the hillocks from being blown away[2].

After these general remarks on Polyps and Polypstocks, we must dwell for a little on the particulars of structure of the different animals that belong to this class. It would be a defective and erroneous idea, to suppose that TREMBLEY'S fresh-water Polyps are to be considered as the *Type* of the class. That we drew the attention of our readers, in the first instance, to the fresh-water Polyp, is merely to be attributed to the historic form which, in introducing this class, we thought useful for the right understanding of it. The animals which live in Polyparies have in several respects a much

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[1] See MILNE EDWARDS, *Observations sur la nature et le mode de croissance des Polypiers, Ann. des Sc. Natur.* Seconde Série, Tom. x. 1838. *Zoologie*, pp. 321—334.

LAMARCK appears to me in some degree to contradict himself, when in one place he calls the polypary a common body possessing an independent life, and producing new individuals upon its surface, which die and are again replaced by new ones, and continuing its life almost unobserved as long as it is surrounded by water alone (*Hist. Nat. des Anim. sans Vert.* I. p. 63, new edition); and in another place denies to the polypary all life, and compares it with the shells of molluscs, *ibid.* II. pp. 86—99. Before this, LINNÆUS, PALLAS and others had recognised in the polypary a proper life, but of late years this opinion, on the authority of LAMARCK, has been almost generally relinquished.

[2] Comp. J. B. FORSTER, *Bemerkungen auf seine Reise um die Welt*, Wien. 1787. 8vo. s. 120, 121; A. VON KOTZEBUE, *Entdeckungs-reise in die Südsee*, III. Weimar 1821, s. 187; QUOY et GAIMARD, *Mémoire sur l'accroisement des Polypes considéré géologiquement, Ann. des Sc. Nat.* VI. 1825. pp. 273—290; EHRENBERG, *Ueber die Natur und Bildung der Corallenbänke des rothen Meeres, Physik. Abhandlungen der Akad. der Wissensch. zu Berlin.* 1832. s. 381—438.

nearer alliance to *Sea-Anemonies* (*Actiniæ*), which CHAMISSO and EISENHARDT had properly classed with Polyps[1], although CUVIER joined them to the Medusæ (*Acalephæ*), LAMARCK and SCHWEIGGER to the Star-fishes (*Echinodermata*). These *Actiniæ* have a tubular form, or resemble truncated cones. By their discoidal base they adhere to rocks, marine shells, and other bodies; but are able to loosen their hold, and to consign themselves to the motions of the water. They can also creep by means of that base, as the belly-footed molluscs (*Gasteropoda*) do by means of their ventral disc. But ordinarily the motions of these animals are restricted to a greater or less expansion of the oral aperture, and to a contraction of the hollow tentacles which surround the mouth in a variable number, but always greater than twelve. These Actiniæ are naked Polyps, rather of a coriaceous than a gelatinous consistence; they were not unknown to the ancients, and are noticed by ARISTOTLE[2] as *Acalephæ*, and by PLINY[3] as *Urticæ*. Such Polyps with Polyp-stocks are the genera *Fungia*, *Caryophylla*, *Astræa*, *Mæandrina*. The Polyps of other Polyparies, as *Isis*, *Alcyonium* (*Lobularia*), *Tubipora*, &c. have eight tentacles, which are flat and notched on the edges or have lateral prolongations. In all these the intestinal canal is a blind sac. But there are other Polyps which, by their more perfect organisation, approach the Molluscs. Their intestinal canal is reflected upwards, and terminates by an opening close to the mouth. AUDOUIN and MILNE EDWARDS observed this structure (1828) in Polyps of the genus *Flustra*[4]: at the same time EHRENBERG published his earlier observations to the same effect, and gave to Polyps, with this organisation, the name of *Bryozoa;* which has been received into the systematic works of zoologists[5],

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[1] *Nov. Act. Acad. Cæsar. Leop. Carol. Natur. Curiosor.* X. p. 354, 355.

[2] Ἔστι δὲ καὶ τὸ τῶν ἀκαληφῶν γένος ἴδιον· προσπέφυκε δὲ ταῖς πέτραις, ὥσπερ ἔνια τῶν ὀστρακοδέρμων· ἀπολύεται δ' ἐνίοτε. Οὐκ ἔχει δὲ ὄστρακον, ἀλλὰ σαρκῶδες πᾶν ἐστιν αὐτοῦ, κ.τ.λ. *De Anim. Hist.* IV. c. 6. These words, in my opinion, apply to Actiniæ alone.

[3] *Hist. Nat.* Lib. IX. c. 68. But that *Medusæ* also (our *Acalephæ*) were by the ancients designated under this name, I will by no means deny.

[4] *Resumé des recherches sur les Animaux sans Vertèbres faites aux îles Chausey, Ann. des Sc. nat.* Tom. XV. 1828. pp. 12, 13.

[5] *Symbolæ physicæ seu Icones et Descriptiones Animalium evertebratorum ex itinere* F. G. HEMPRICH *et* C. G. EHRENBERG, Dec. I. Berolini, 1828. folio. *Polypi*, p. 2. Also

and is now commonly used. MILNE EDWARDS makes a separate class of these creatures, and places it amongst the Molluscs, after the naked *Acephala*, or *Tunicata*. Their arms are beset with cilia, which however are also remarked in some other Polyps, and consequently are not a distinctive character of *Bryozoa*, as would seem to be implied by the name *Ciliobrachiata*. To these *Bryozoa* belong the genera *Alcyonella*, *Eschara*, and *Flustra*. The remaining Polyps we shall name, with EHRENBERG, *Anthozoa*.

The simple stomach of the *Anthozoa* is, for the most part, separated from the cavity of the body. In *Actinia* this space is divided into many prismatic cells by partitions that stretch perpendicularly from the outer surface of the stomach to the innermost surface of the covering of the body. Similar partitions are found in many *Anthozoa*, though in much smaller number. One or more openings conduct from the bottom of the stomach to the cavity of the body, or to the general common cavity of the Polypstock[1]. In *Hydra* there is no special cavity of the body, but the cavity of the stomach is in immediate connexion with the walls of the body. It was formerly erroneously believed that the stomach of this animal is simply an excavation of its body, and that the structure of both surfaces is the same. The internal surface is coated with conical cells whose points are directed inwards[2]. The external surface, on the contrary, is formed of flat cells, and contains oval vesicles, from which a long delicate thread can be projected, (*Angel-organ* of the Germans[2]). TREMBLEY, amongst his many experiments on the reproductive power of the fresh-water Polyp, even turned the body inside out, like the reversed finger of a glove. Nevertheless, the creature continued to live, and took food. This may be explained by a change of structure, the consequence of the violence of the experiment. In *Bryozoa*, the intestinal canal is freely suspended in the cavity of the body: a longer or shorter œsophagus leads to a muscular stomach, lined, in some cases, with horny teeth, closely

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GRANT, as early as 1827, had observed the reverting intestinal canal, and the vibrating cilia on the arms of *Flustra*. *Edinb. New Philos. Journ.* III. pp. 107—337.

[1] LISTER, *Philos. Transac.* 1834, p. 371, Pl. VIII. fig. 3 in *Sertularia*. MILNE EDWARDS in the new illustrated edition of CUVIER, *Règne Anim. Zooph.* Pl. LXXX. in *Isis nobilis*, &c.

[2] See CORDA, *Nov. Act. Acad. Cæsar. Leop. Carol. Natur. Curiosor.* Tom. XVIII. *Ann. des Sc. natur.* Tome VIII. *Zoologie*, p. 363.

set in rhomboïdal rows: then comes a second stomach ending below in a blind sac that is continued at the upper part into an intestine, which ascends by the side of the stomach and œsophagus, and near the mouth, or a little below it, terminates in the *anus*. Brown follicles cover the external wall of the stomach, and seem to represent the liver[1]. In some Polyps a circulating system has been observed, or at least vessels, which probably arise as branches from the intestinal tube, anastomose with one another in the Polyp-stock, and effect a communication between the different individuals[2]. In many, moreover, a stream of water is found, which penetrates by the mouth into the canals of the Polypary. It has been observed that the flow is caused by cilia on the walls of the canals. Probably this motion is in connexion with the function of Respiration. LISTER saw in the stem of *Plumularia pluma* LAM. the stream in the same canal moving alternately in opposite directions[3].

We have seen above that propagation in Polyps is usually effected by buds. In *Hydra*, after being developed, they are separated: in others they remain attached to the parent-stem. But besides this mode of propagation, a sexual generation has been observed in this class. In *Hydra*, about winter-time, a periodical development of eggs on the inferior part of the body has been observed. The thin membrane, surrounding the egg as it projects from the body, bursts, and the egg attaches itself to some object or other in the water. In some species the yolk-membrane is covered with cloven ramiform processes, as if with spines. After two or three months the young one is visible. The conical excrescences which arise higher up on the body at the base of the arms, and which are perforated at the point, contain *spermatozoa*; and may, to a certain extent, be considered to be external *testes*[4]. These genital

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[1] See A. FARRE, *Observations on the minute structure of the higher forms of Polypi. Phil. Trans.* 1837, pp. 387—426. Pl. XX—XXVII.

[2] MILNE EDWARDS, *Ann. des Sc. nat.* sec. Série, IV. *Zool.* p. 338.

[3] *Phil. Trans.* 1834, p. 369.

[4] The egg of *Hydra* was figured long ago by ROESEL, *Suppl.* Tab. LXXXIII. fig. 1 a and fig. 2. See also the figures of EHRENBERG and ERDL in WAGNER, *Icon. Zootom.* Tab. XXXIV. figs. 8 and 10, and of LAURENT, *Recherches sur l'Hydre et l'Eponge d'eau douce*, Paris (1844), Pl. II. Here figs. 9—14 the exclusion from the egg is figured, which had also been observed by Pallas: "*Ovula autumno generare Hydras observatum est... polypi compendium per hyemem duraturum continentia.—Hanc per ovula propagationem bis meis oculis perfectam observavi.*" *Elench. Zoophytor.* p. 28.

organs may exist at the same time, and in variable number, in one and the same individual. And many other Polyps are also hermaphrodite. In others again the sexes are separate: whether both male and female individuals occur on one and the same stem (*Monœcia*, as in Plants), or one Polypstock bears only males, another only females (*Diœcia*). The last is the case of *Veretillum*. In the *Bryozoa*, *Monœcia* appears to prevail universally, yet so that (to judge from the investigations of NORDMANN in *Tendra zostericola*, and of VAN BENEDEN in *Alcyonella*) the cells which contain Polyps with eggs are more numerous than those with *spermatozoa*. These peculiar constituents of the seed (vid. above, p. 43), of which the motions are so striking under the microscope, have, of late years, caused the important discovery of the sexual propagation of Polyps; but for them, ovaries alone would now, as twenty years ago, be ascribed to this class, especially as the seed-secreting organs (*testes*) are not to be distinguished in it, as to external appearance, from those that prepare the germs (*ovaria*)[1]. In those *Anthozoa* that have, like the *Actiniæ*, a cavity of the body distinct from that of the stomach, they are situated between or upon the partitions that divide that cavity into cells (see above, p. 67). In *Sertularia* and *Campanularia* most of the Polyps are without sex, whilst cells with ova are developed in the axillæ of the branches.

Propagation by spontaneous division does not occur in most Polyps. In *Caryophylla* there is a complete longitudinal fission, occasioning the dichotomous form of the Polypary, since two Polyps come from one, four from two, &c. If the longitudinal fission be incomplete, cells of irregular form arise, as in *Mœandrina*.

In most Polyps the power of reproduction is very great. TREMBLEY'S experiments on the fresh-water Polyp are well known: he divided them longitudinally and transversely, and every piece formed a new animal[2]. ROESEL found that even the tentacles of

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[1] Such is the case also in *Mollusca*, nay even in some fishes; and in general the sexual organs in the animal kingdom possess a similarity in the two sexes, which was observed by the ancients, and occasioned many fanciful appellations and comparisons.

[2] Hence LINNÆUS borrowed the name *Hydra* for this animal genus, from a comparison with the *Hydra* of mythology:

*... ab ipso*
*Ducit opes animumque ferro.*
HORAT. *Od.* IV. 60.

arms, when separated, grew into new Polyps; an experiment which did not succeed with TREMBLEY. The power of reproduction is in *Actiniæ* just as great; they regenerate parts that have been cut away, and admit of propagation by artificial division, as DICQUEMARE especially has shewn by his experiments.

Before leaving the propagation of Polyps, we must notice those late observations which indicate so close an affinity between *Medusæ* and certain *Polyps*, that in time probably a great revolution will be made in the systematic arrangement of the animal kingdom. In *Syncoryne*, for instance, and *Coryne* (*Clava*), and certain *Campanulariæ* bell-shaped appendages or off-shoots have been noticed, which at length are separated from the stem, and resemble minute Medusæ. Conversely, also, the observations of SARS and of VON SIEBOLD have shewn that *Medusæ* come from the egg under an oblong form resembling that of infusories beset with cilia: these move freely, at first, then fix themselves, lose their cilia, become clavate, acquire arms, and perfectly resemble *Hydra*. These *hydra*-like forms divide by transverse indentations, and separate into rings from which *Medusæ* arise.

It is possible, therefore, that all *hydra*-form Polyps may be only imperfect forms of *Medusæ*. And if so, those animals which RÉAUMUR first named Polyps, would no longer belong to this class. But on this supposition it is wonderful that *Spermatozoa* should be observed in *Hydra* and *Coryne:* a fact that may cause us to hesitate before we conclude, with DUJARDIN, that the eggs, described above (p. 68), are *Bulbilli*. At all events the perfect form of *Hydra* would then be unknown[1].

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[1] We cannot detail these observations more particularly, without being diffuse beyond our object. Let it suffice to refer the reader to LOVÉN *Stockh. Vetensk. Akad. Handl.* 1836; WIEGMANN'S *Archiv für Naturgesch.* v. 1837, s. 219—262, s. 321—326; *Ann. des Sc. nat. sec. Série.* Tom. XV. *Zool.* pp. 157—176. (*Observations sur le développement et les metamorphoses des genres Campanulaire et Syncoryne.*)

SARS, *Beskrievelser og Jagttagelser over nogle mærkelige eller nije i Havet ved der Bergenske Kyst levende Dyr.* Bergen, 1835.

C. TH. V. SIEBOLD, *Neueste Schriften der naturf. Gesellsch. in Danzig* III. 2 Heft 1839, s. 26—35.

SARS, *Mém. sur le développement de la Medusa aurita et de la Cyanea capillata. Ann. des Sc. nat. sec. Série.* Tom. XVI. *Zoologie,* pp. 321—348.

STEENSTRUP *om Fortplantning og Udvikling gjennem vexlende Generationsraekker.* Kjöbenhavn, 1842. 4o. (Translated by G. BUSK for the *Ray Soc.* from the German Translat. 1845, *On the Alternation of Generations.*)

Of the nervous system of Polyps little is known; it has not been described as a connected whole, but different observers have imagined that they had discovered ganglia or a nervous ring near the mouth. From analogy it is probable that the nervous system, where it exists, does form a ring round the mouth; and that the threads, which SPIX described in the pedal disc of *Actiniæ* as nerves, can on this account scarcely be considered to be such. As organs of sense, four coloured spots at the edge of the disc have been observed in the *Medusa*-form products of *Syncoryne* and *Coryne fritillaria* of STEENSTRUP, which entirely resemble the parts that EHRENBERG considers to be eyes in *Medusa*. Still more distinct is this organ in a form described by QUATREFAGES, which he names *Eleutheria dichotoma*. Here this author found six eyes with a hemispherical lens, a granular pigment of a red colour, and a spherical projection of the integument closing the eye like a cornea[1].

In *Bryozoa* the muscular system is most largely developed, and serves principally to retract the animal within its cell. It protrudes itself partly by straightening the alimentary canal, partly by means of transverse muscular fibres which contract the diameter of the visceral cavity, and in that way elongate it[2]. Traces of a muscular system have also been met with in other Polyps.

As to the geographic distribution of Polyps, we have only imperfect notices. Fresh-water Polyps, *Hydra*, *Alcyonella*, *Plumatella*, have, as far as I know, only been observed in Europe; but from this to conclude that they do not occur in tropical regions, would probably be premature. Still EHRENBERG found no *Hydræ* in Africa and Arabia. *Actiniæ* are met with in all seas. The Polyps with polyparies, which are almost all inhabitants of the sea, are richest in species in warm regions; *Flustra*, amongst the *Bryozoa*, is it seems an exception to this: the European species of this genus are about as numerous as the foreign: these last come principally from New Holland; *Gorgonia* occurs in all seas, but

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VAN BENEDEN, *Mém. sur les Campanulaires de la côte d'Ostende, Mém. de l'Acad. Royale de Bruxelles*, XVII. 1843. *Ann. des Sc. natur., sec. Série.* Tom. XX. *Zool.* pp. 350—373.

DUJARDIN, *Mémoire sur le dévéloppement des Méduses et des Polypes hydraires. Ann. des. Sc. Nat. 3e Série.* Tom. IV. 1845. *Zoologie*, pp. 257—281. Pl. XIV. XV.

[1] *Ann. des Sc. Natur. sec. Série.* Tome XVIII. p. 280. Pl. VIII. fig. 6.

[2] Minutely detailed by FARRE in *Bowerbankia, Phil. Transact.* 1837. pp. 393—396.

nearly one-half of the numerous species is found in America. Of swimming polyparies (*Pennatulæ*), many species are found in the Mediterranean, the Indian Ocean and the North Sea, and the large *Umbellaria* of Greenland, which attains a length of six feet, is remarkable. Of the stony polyparies, the greater number occur in the seas of hot countries, as *ex. gr. Madrepora*, especially *Astræa*, *Caryophylla*, *Fungia*, *Mœandrina*. Most of the species of the last genus are found in the Indian Ocean and South Pacific. The Red Sea also has very many species from the division of these stony polyparies. More than one-fourth of the known species of this class were found there by EHRENBERG. Notwithstanding the proximity, it seems that the Red Sea, with the exception of some species of *Actinia*, has no species in common with the Mediterranean. *Isis nobilis* (*Corallium rubrum*) appears to occur in the Mediterranean alone.

Of many genera numerous fossil species are found, especially of those whose species now live in hot regions. Thus the genus *Astræa* numbers more fossil than living species: and these petrified remains belong principally to the Jura- and chalk-formations. Still more numerous are the fossil species, as compared with those now living, in the genus *Turbinolia*. A genus which appears to connect *Fungia* and *Turbinolia*, *Cyathophyllum* of GOLDFUSS, has quite died out, and occurs in transition limestone. In the same way fossil species alone are found of the genera *Ceriopora*, *Favositis*, *Pustulopora*, *Heteropora*, *Catinipora* and *Aulopora*. The fossil *Polyparies* prove, like all other remains of an earlier vegetable and animal world, that the surface of our earth had in earlier times a higher mean temperature than it has now.

# SYSTEMATIC

# ARRANGEMENT OF POLYPS.

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## CLASS II.

### POLYPI.

ANIMALS contractile, having an intestinal cavity, with distinct terminal mouth, surrounded by tentacles or radiating lobes, seldom free, oftener affixed, aquatic; usually secreting a hard calcareous or horny body (*polypary*), and adhering to it.

Propagation is by eggs, gems, stolons. Usually compound animals are formed of many individuals cohering.

#### SECTION I. *Anthozoa* EHRENB.

Aperture of the nutrient canal single. Tentacles contractile, mostly without vibratile cilia.

#### ORDER I. *Hydriformia.*

Tentacles of variable number. Nutrient canal excavated in the parenchyme of the body, not surrounded by an abdominal cavity.

Family I. *Hydrina.* Naked, free, spontaneously affixed, with deciduous progeny.

*Hydra* L. Body cylindrical, narrowed into a pedicle, simple or ramose from the progeny not having been detached. Mouth crowned with tentacles, round, contractile, in a single whorl.

*Armed-Polyp:* Sp. *Hydra viridis,* TREMB. Pl. I. fig.; ROES. *Ins.* III. *Polyp.* Tab. 88, 89. This green species was the first which TREMBLEY found; it is rarer and smaller than the others.—*H. Grisea,* TREMB. Pl. I. fig. 2;—*H. fusca,* TREMB. Pl. I. fig. 3, 4, *polype à longs bras,*

ROES. *Ins.* III. *Polyp.* Tab. 84, 85, 87; TREMBLEY performed most of his experiments on these last two species. Comp. what is said at pp. 67, 69.

On this genus compare the work of TREMBLEY, noted in p. 60, and of LAURENT, p. 68. The first discoverer of the genus was LEEUWENHOECK, who probably observed *Hydra grisea*. He announced this animal in a letter to the Royal Society of London, of Dec. 25, 1702, observed its propagation by gemmation, figuring it with two young ones, and especially described the great contractility of the arms. *Phil. Trans.* No. 283. Vol. XXIII. *for the years* 1702, 1703, pp. 1304—1311. This description, however, had been forgotten when TREMBLEY discovered the animal a second time.

*Clava* GMEL. *Coryne* of authors, not of GAERTN. Body clavate. Tentacles scattered.

These animals are marine, and adhere to different bodies. Propagation is effected by buds of a round or bell-shaped form, which contain ova or spermatozoa, and which occasionally detach themselves from the stem on which they were developed, swim freely about, and resemble small Medusæ.

Sp. *Clava parasitica* GM., *Hydra multicornis*, FORSKÅL, *Icon. Rerum natur. Hauniæ*, 1776. Tab. XXVI. fig. b, B. *Cor. squamata* MUELL. *Zool. Danic.* Tab. IV. about three lines, according to RÄTHKE, ½ inch long. RATHKE discovered *Spermatozoa* in the swellings called *Squamæ* by MUELLER; vid. WIEGMANN'S and ERICHSON'S *Archiv. f. Naturgesch.* 1844. S. 155—165; *Ann. des Sc. Nat.* 3*ieme Série.* II. 1844. *Zool.* pp. 201—210; WAGNER found eggs in these swellings, *Icon. Zootom.* Tab. XXXIV. fig. 16. Thus the sexes appear to be distinct.

*Eleutheria* QUATREFAGES. Body hemispherical, hollow. Tentacles six, divided into two retractile branches, terminating in a round head. Six eyes placed at the base of the tentacles.

Sp. *Eleutheria dichotoma*, DE QUATREFAGES, *Mémoire sur l'Eleutherie dichotome. Ann. des Sc. nat. sec. Série.* Tom. XVII. 1842. *Zool.* pp. 272—288, Pl. VIII. Discovered in the Atlantic ocean, on the shore of the Islands *Chausey*, Dep. *La Manche*, ½ millim. in diameter. There were eggs in the posterior part of the body. This form is probably a free bud for the propagation of some species of *Coryne*, *Sertularia* or *Tubularia*. See V. BENEDEN, *Bulletin de l'Acad. Royale de Bruxelles*, Tom. XI. No. 10. QUATREFAGES, *ib.* Tom. XII. No. 2.

[Genus *Pedicellaria* MUELL. delendum[1].]

[1] Pediculated organs with three valves are found between the spines and tentacles, or suckers, of the sea-urchin, which MUELLER took to be parasitic Polyps, and of which he formed the genus *Pedicellaria*.

Family II. *Sertularinæ*. Polyps affixed by a membranaceous pallium secreting the Polypary, or loricated, included in a tubule or cell.

*Hydractinia* VAN BENED., *Echinochorium* HASSALL, *Dysmorphosa* PHILIPPI, *Synhydra* QUATREFAGES. Polyps of two sorts, sterile and fertile, set on an incrusting polypary. Tentacles numerous. The fertile polyps without mouth.

Sp. *Hydractinea lactea, Dismorphosa conchicola,* PHILIPPI, *Synhydra parasites* QUATREF. *Ann. des Sc. nat. sec. Série. Zool.* Tom. XX. Pl. VIII. IX., HASSALL, *Ann. and Mag. of Nat. Hist.* Vol. VII. Pl. X. fig. 5, PHILIPPI, WIEGM. u. ERICHS. *Archiv,* VIII. 1842. Taf. I. fig. 3. Turbinate shells are often found incrusted with a greyish-brown firm covering, difficult to remove: this is the common body to which the several polyps, some millimeters long, are attached, which have of late years been described by different observers. QUATREFAGES found his specimens on the shells of *Turbo* and *Buccinum,* in which the hermit-crab (*Pagurus*) had taken up his abode; so also BASTER previously, *natuurk. Uitsp.* I. Tab. III. fig. 5. According to QUATREFAGES, it is by no means established that all the above-mentioned names refer, as VAN BENEDEN determines, to the same animal.

*Coryne* GAERTN., *Stipula* SARS, *Syncoryna* EHRENB. Polyps with scattered tentacles, nodiferous or globose at the tip. Polypary papyraceous, subramose, with polyps at the extremities of the tubes, not retractile within the tubes.

The name *Coryne* of GAERTNER, PALLAS *Spicileg. Zool.* Fasc. X. 1774, pp. 36, 40, 41, has by later writers been perversely given to other kinds, and the original typical species been named *Syncoryne.*

Sp. *Coryne pusilla* GAERTN., *Coryne glandulosa* PALL. *Spicil. Zool.* X. Tab. IV. fig. 8, &c. Compare on this genus LOVÉN, *Kong. Vetensk. Akad. Handling.* 1835; WIEGM. *Archiv,* III. 1837. pp. 321—326, *Ann. des Sc. Nat. 2 Série. Zool.* XV. p. 170, Pl. VIII. JOHNSTON, *Hist. of Brit. Zoophytes,* pp. 39—41, Pl. II.

*Tubularia* L. (in part). Polyps with a double coronet or whorl of tentacles, the upper surrounding the mouth. Polypary affixed by the base, tubular, gelatinous or membranaceous, with polyps terminal, not retractile.

*a) Simple Tubulariæ.*

Sp. *Tubularia indivisa* L., *Tubul. calamaris* PALL., JUSSIEU, *Mém. de l'Acad. Royale des Sc.* 1742. p. 296. Pl. X. fig. 2. A, B; ELLIS, *Corall.* Pl. XVI. c; LISTER, *Phil. Transact.* 1834. p. 266. Pl. VIII. fig. 1, &c.; JOHNSTON, *Hist. Br. Zooph.* p. 48. pl. III.

*b) Branched Tubulariæ.* [Genus *Eudendrium* EHR.]

Sp. *Tubul. ramosa* L., ELL. *Corall.* Pl. XVI. fig. a. Pl. XVII. a, A, &c.

*Corymorpha* SARS.

Comp. SARS, *Beskrivelse og Jagttagelser over nogle maerkelige eller nye i Havet ved der Bergenske Kyst levende Dyr.* Bergen. 1835. Pl. I. fig. 3. FORBES and GOODSIR, *On the Corymorpha nutans, Ann. and Mag. of Nat. Hist.* v. 1840. pp. 309—315; JOHNSTON, *Hist. Br. Zooph.* pp. 54—56. Pl. VII. figs. 3—6.

*Pennaria* GOLDF. Polyps clavate, the club with scattered tentacles globose at the extremity, and with a whorl of longer tentacles at the base. Polypary ramose, with branches alternate polypiferous on one side (with Polyps secund.)

Sp. *Pennaria Cavolinii, Sertularia pennaria* CAVOLINI, pp. 134—159. Tab. V.

*Campanularia* LAM. (*Sertulariæ species* L., EHR.) Polyps funnel-shaped, with mouth situated at the extremity of a retractile conical tubercle. A whorl of tentacles, numerous, warty, with dart-cells at the base of the tubercle. The Polypary corneous, tubular, branched, with cells campanulated, pedunculate, the pedicle long, continuous with the stem. The terminal cells sterile, the axillary oviferous.

Comp. LISTER, *Phil. Trans.* 1834, p. 372 &c.; LOVÉN, *Kong. Vetensk. Akad. Handl.*, WIEGMANN'S *Archiv*, III. s. 249—262. *Ann. des Sc. nat.* 2e *série, Zool.* XV. p. 151; VAN BENEDEN, *Mém. sur les Campanulaires de la côte d'Ostende.* Bruxelles, 1843, 4°. (*Mém. de l'Acad. de Bruxelles*, XVII.), *Ann. des Sc. nat.* 2e *série, Zool.* XX. pp. 350—369. Pl. 13 (Extract).

Sp. *Campanularia dichotoma* LAM., *Sertularia geniculata* L., ELLIS, *Corall.* Pl. XII. No. 18 A, a. C, c. Pl. XXXVIII. fig. 3, &c.

*Sertularia* L. (exclusive of several species). Polyps funnel-shaped; tentacles hispid, numerous, arranged in a whorl at the base of the mouth. Polypary corneous, simple or ramose, with cup-shaped cells sessile, or subpedunculate, with short pedicle, distinct from the stalk. Polypiferous cells sterile; others fertile, oviferous, scattered over the stalk and branches, situated usually near the base.

The Polyps of this genus do not differ from those of the former, but the cells are non-pediculate, or the very short pedicle is dis-

tinctly inserted into an indent of the stem. The last form the genus *Laomedea* LAMOUROUX. Those which have cells entirely without pedicle may be thus divided:

*a*) with cells bifarious or scattered (*Sertularia* LAM.)

Sp. *Sertularia abietina* L., ELL. *Corall.* Pl. I. No. 2. B, b; *Sertularia pumila* L., ELL. *Corall.* Pl. V. No. 8. fig. a, A, LISTER, *Phil. Trans.* 1834. Pl. VIII. fig. 3, &c. JOHNSTON, *Br. Zooph.* p. 66, Pl. XI. figs. 3, 4, and p. 75, Pl. XIII. fig. 1.

*b*) with cells verticillate (*Antennularia* LAM.)

Sp. *Sertularia antennina* L., ELL. *Corall.* Pl. IX a.

*c*) with cells secund (*Plumularia* LAM.)

Sp. *Sertularia pluma* ELL. *Corall.* Pl. VII. fig. b, B, &c. JOHNSTON, *Br. Zooph.* p. 92, Pl. XXIII. figs. 1—3.[1]

## ORDER II. *Octactinia.*

Tentacles eight, pinnate. Nutrient canal contained in a distinct abdominal cavity, connected with it by interposed lamellæ.

Family III. *Xenina.* Common body, fleshy or membraneous, affixed by the base. Polyps not retractile, with pinnate tentacles.

*Xenia* SAV. Common body growing upwards into stems divided at the top, branches short. Polyps fasciculate, collected at the extremities of the branches into globose heads, or umbels.

Sp. *Xenia umbellata* SAVIGNY, *Déscription de l'Egypte, Polypes,* Tab. I. fig. 3; SCHWEIGGER'S *Beobachtungen auf naturhist. Reisen.* Tab. V. fig. 48; in the Red Sea.

*Anthelia* SAV. Common body, membraneous, plane, spread over marine bodies, stoloniferous. Polyps standing out, erect, crowded, at the surface of the membrane.

Sp. *Anthelia glauca* SAVIGNY, *Descr. de l'Egypte, Polypes,* Tab. I. fig. 7.

*Note.* Genus *Rhizoxenia* EHRENB. is founded on a figure of *Zoantha thalassantha* of LESSON in the zoological plates of DUPERRY'S voyage (*Voyage autour du Monde sur la Corvette la Coquille, pendant les annees* 1822—1825). The common body is

[1] Many species which have been referred to *Sertularia*, belong to the *Bryozoa*. Amongst them are those which LAMARCK has brought together under the genus *Seriolaria*. See VAN DER HOEVEN'S *Handb. der Dierkunde*, first edition, I. p. 76.

made up of stolons, connecting tubes erect, ventricose, striated, each containing a Polyp. Whether the Polyps are retractile or not, does not appear. Comp. genus *Evagora* PHILIPPI (p. 79).

Family IV. *Halcyonina.* Polypary fleshy, spongy, perforated by many canals, and crowded with microscopic calcareous spicula. The Polyps associated in the polypary, retractile, with tentacles pinnate.

This family has its name from the genus *Alcyonium* L. called in Holland *Zeeschuim* or *Zeekurk* (sea-foam or sea-cork). Under the genus *Alcyonium* of LINNÆUS were comprised species which, like *Alcyonium* SCHLOSSERI, belong to the Molluscs (*Ascidiæ*), as SAVIGNY has shewn; other species are *Bryozoa* (*Alcyon. gelatinosum*). The genus *Alcyonium* of LAMARCK contains plant-like forms without polyps. To these spongy plants belongs also the genus *Alcyonellum* QUOY (*Euplectella* OWEN). Consequently there remain for this family those species alone which LAMARCK has united under the genus *Lobularia*, and probably it would be well, according to the suggestion of SCHWEIGGER, to reject the name *Alcyonium* altogether, for the sake of avoiding confusion.

On the sponges comp. SCHWEIGGER, *Handb. der Naturgesch. der skelettlosen ungegliederten Thiere*, s. 370—374, R. E. GRANT, in *Edinb. Philos. Journ.* Vol. XIII. p. 333, H. F. LINK, *Ueber Pflanzenthiere überhaupt und die dazu gerechneten Gewächse besonders. Physik. Abhandl. der Akad. der Wissensch. zu Berlin a. d.* Jahre 1830. s. 109—123.

*Alcyonidia* MILNE EDW. Polypary simple or ramose, with a basal portion coriaceous, a terminal polypiferous, soft, retractile by invagination within the former. Polyps with tentacles having pinnæ, which are hollow, in a single row at the margin, retractile separately.

Sp. *Alcyonidia elegans* MILNE EDWARDS, *Ann. des. Sc. nat. 2e Sér.* IV. 1835. pp. 323—333. Pl. 12, 13. In the Mediterranean at Algiers.

*Nephtœa* SAV. (according to EHRENB. to be written *Nephthya*). Polypary ramulose or shrubby, with Polyps retractile within warts armed with spicula.

Sp. *Nephtœa innominata* BLAINV., *Nephthya Savignyii* EHRENB., *Ammothea Chabrolii* AUDOUIN, *Descr. de l'Egypte, Polypes*, Pl. II. fig. 5. To the same genus belongs *Sphonyodes celosia* LESSON, *Illustrations de Zoologie*, Pl. XXI. which seems scarcely different from *Alcyonium floridum* ESPER, *Alcyon.* Tab. XVI.

*Ammothea* SAV. Polypary ramulose or shrubby, with Polyps retractile into unarmed warts, clustered on the last branchlets.

Sp. *Ammothea virescens* SAVIGNY, *Descr. de l'Egypte, Polypes*, Pl. II. fig. 6.

*Sympodium* EHRENB. Common body, membraneous, effuse, with Polyps retractile into unarmed warts that project only slightly, without stem.

Sp. *Sympod. fuliginosum* EHRENB., *Anthelicæ* species AUDOUIN, *Descr. de l'Egypte, Polyp.* Pl. I. fig. 6.

Some *Anthelicæ* have retractile Polyps. They cover various marine bodies as an incrustation. One species of this genus was described by PALLAS as the crust of a *Gorgonia: Gorg. coralloides, Elench. Zoophytor.* p. 192, ESPER *Gorgon.* Tab. XXXII.

*Evagora* PHILIPPI. Polypary incrusting, formed of stolons conjoining the several Polyps. Polyps with a basal portion harder, coriaceous, a terminal retractile, soft.

Sp. *Evagora rosea* PHILIPPI, WIEGMANN u. ERICHSON *Archiv f. Naturgesch.* VIII. 1842, I. s. 36. Taf. I, f. 2, c.—*Zoantha thalassantha* LESSON (see above, p. 77) appears to be another larger species of this genus.

*Alcyonium* CUV. MILNE EDW. (*Lobularia* LAM. *Alcyonii species* L.) Body fleshy, turgid, usually inciso-lobate, covered with Polyps scattered.

The separate polyps are entirely retractile within the common body, formed by the union or concretion of the external covering of the polyps. This is thick and spongy, and contains a great quantity of small irregular crystals of carbonate of lime. Propagation is by eggs and buds (*gemmæ*). The form and size may be very different in one and the same species, so that the distinction of some of the species proposed by authors is uncertain.

Sp. *Alcyonium lobatum* PALL., *Alc. digitatum* L., JUSSIEU, *Mém. de l'Acad. des Sc. de Paris*, 1742. Pl. IX. f. 1. A—J; ELL. *Corall.* Pl. XXXIII. fig. a, A; SPIX, *Ann. du Mus.* XIII. 1809. Pl. XXXIII. fig. 8 (named *Alc. exos*); LAMOUROUX, *Hist. des Polypiers flexibles*, Pl. XII. fig. 4, Pl. XIII. Pl. XIV. fig. 1, JOHNSTON, *Hist. Br. Zooph.* 174. Pll. XXXIV. XXXIV*. This species, called by the Dutch fishermen, according to Pallas, *dooden manshand* or *duimen* (deadman's hand or thumb), occurs in the North Sea, and attains a size of 0.14—0.2 millim.; the form is very irregular, which, as it seems to me, the name given to Pallas well indicates; the colour is brown-yellow.—*Alc. palmatum* PALL. *Alc. exos* L., BOHADSCH *De quibusd. anim. mar.* Tab. IX. f. 6, 7. ESPER *Alcyon.* Tab. II. &c. This species occurs in the Mediterranean; it has the form of a little tree or shrub, and the branches are coloured

red. It has been specially investigated by MILNE EDWARDS, and very beautifully figured in his *Observations sur les Alcyons. Ann. des Sc. nat. 2e Sér.* Tom. IV. *Zool.* pp. 333—343. Pl. 14, 15.

Family V. *Pennatulina.* Stem free, fleshy, containing internally an axis stony or horny. Polyps naked, aggregated on the common stem, with tentacles pinnate or pennatifid.

Sea-Feathers (*Polypi natantes* s. *Pennæ marinæ*). The opinion, that these polypstocks swim about in the sea, appears to be unfounded. The stem is fixed in the ooze at the bottom of the sea, or the polypary lies on the bottom; it is only when the waves or the fishermen's nets have broken the *Pennatula* loose, that it swims free in the water. Comp. W. RAPP *Ueber Polypen u. Actinien* s. 8, 34. COSTA in FRORIEP'S *neue Notizen*, Bd. XXI. Feb. 1842, s. 154. Many species are phosphorescent: *Pennatula phosphorea, Pen. grisea, Pen. rubra* (*P. granulosa* LAM.), *Veretillum cynomorium* from the Mediterranean and *Pen. argentea* from the Indian sea.

The genus *Encrinus*, placed by LAMARCK amongst the sea-feathers, belongs to the Echinoderms, and is, as ELLIS long ago remarked, a species of star-fish with a stem. *Nat. Hist of Corall.*

A. Shaft pinnated in scales at the upper part, pinnæ polypiferous.

*Pennatula* L. (exclusive of species). Shaft fleshy, at the lower part naked, at the upper pinnate, axis stony. Pinnæ two-ranked, patent, plicate, dentate on the upper margin.

Sp. *Pennatula grisea* L., *Pennatula spinosa* LAM., ALBINI *Annot. Acad.* Lib. I. Tab. VI. figs. 1, 2, BOHADSCH *De quibusd. animalib. mar.* Tab. IX. figs. 1—3, ESPER *Pflanzenth. Pennat.* Tab. I. *Pen. rubra* L., *Pen. granulosa* LAM., ALBIN. l. l. figs. 3, 4, ESPER *Pflanzenth. Pennat.* Tab. II. both from the Mediterranean.

*Virgularia* LAM. Shaft elongate, slender, naked below, pinnated above, with sub-stony axis. Pinnæ small, unarmed.

Sp. *Virgularia mirabilis, Pennat. mirabilis* MUELL. (not L.) *Zool. Danic.* Tab. XI. CUV. *R. Ani. édit. illustr., Zoophyt.* Pl. XCI. fig. 2.

B. Shaft simple, with polypiferous warts or papillæ at the upper part.

*Funiculina* LAM. (*Pavonaria* and *Scirparia* CUV.) Shaft elongate, filiform, with axis horny or sub-stony. Polyps arranged in series, secund or alternate.

*a*) Polyps secund (*Pavonaria* Cuv.)

Sp. *Funicu'ina antennina, Pennatula quadrangularis* Pall., *Pennat. antennina* L., Bohadsch *De quibusd. Anim. mar.* Tab. ix. fig. 4; in the Mediterranean, more than two feet long. [Found near Oban, Argyleshire, forty-eight inches in length, by Prof. Forbes. Vid. Johnston, *Hist. Br. Zooph.* p. 165, Pl. xxxi.]

*b*) Polyps alternate (*Scirparia* Cuv.)

Sp. *Pennatula mirabilis* L.[1]

C. Shaft simple, Polyps scattered, sessile.

*Veretillum* Cuv. Body cylindrical, fleshy, upwards polypiferous, with large Polyps. Axis like a ligament or osseous, short.

Sp. *Veretillum cynomorium, Pennatula cynomorium* Pall. *Misc. Zool.* Tab. xiii. f. 1—4, Rapp, *Nov. Act. Acad. Cæsar. Leop. Carol. Natur. Curios.* xiv. 2. 1829. Tab. xxxviii. fig. 1. Erdl in Wagner *Icon. Zootom.* Tab. xxxiv. fig. 1. Mediterranean, &c.

D. Shaft simple, polypiferous at the extremity only, polyps grouped in an umbel.

*Umbellularia* Lam. Body elongate, slender, with a long osseous axis. Polyps large, terminal.

Sp. *Umbellaria groenlandica, Pennatula encrinus* Pall.; Ell. *Corall.* Tab. xxxvii. taken in very deep water at 79° N. L.

E. Shaft short, cylindrical, dilated into a flattened reniform expansion, which is polypiferous on one side.

*Renilla* Lam.

Sp. *Renilla americana* Lam., *Pennatula reniformis* Pall., Schweigger *Beob. auf naturhist. Reisen.* Tab. ii. fig. 10;—*Renilla violacea* Quoy et Gaimard *Voyage de l'Uranie, Zoologie.* Pl. lxxxvi. fig. 5—7, Cuv. *R. Anim. édit. illustrée, Zoophyt.* Pl. xcr. fig. 3.

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[1] *Scirparia* or *Scirpearia Cuv.* is said to be distinguished by Polyps placed alternate on the two sides. This genus is founded on *Pennatula mirabilis, Polypus mirabilis* Linn. *Mus. Adolph. Frederici Regis,* Holmiæ, 1754. Fol. Tab. xix. fig. 4. p. 96. It is very possible that Linnæus afterwards mistook a foreign species (from China, see *Amœnit. Acad.* iv. p. 257) for one from the North Sea (*Fauna Suecica,* p. 543, "*habitat in oceano Norvegico*"), and this last may be *Virgularia mirabilis.* To me the genus *Scirparia* appears very doubtful. The type which served for Linnæus' description, was not known at Stockholm, as my friend Prof. Sundevall wrote to me (4 July, 1846).

Family VI. *Tubiporina.* Polypary calcareous, of parallel tubes, close set, conjoined by transverse partitions. Polyps tubular, the neck retractile, soft, the lower part indurated, forming the polypary. Tentacles in single or double row at the margin, retractile by involution.

*Tubipora* L. (exclusive of several species).

Sp. *Tubipora musica* L., *Tubularia* TOURNEF. *Instit. Rei herbariæ* Tab. 342 (the Polypary); for this animal and its organisation compare especially the beautiful plate in FREYCINET, *Voyage de l'Uranie, Zool.* Pl. 88. The *Organ-Coral* consists of cylindrical, hollow tubes, standing perpendicular with transverse partitions. These last arise from a horizontal expansion, which at the top of the tube surrounds its circumference radially. The expansions connect the tubes together, and become partitions when the tubes above them begin to grow. From this elongation of the tubes their jointed form arises, and when the growth ceases, they form a new transverse expansion round the wall of their aperture. EHRENBERG has distinguished the species of this genus more accurately: they are usually comprised under the collective name of *Tubipora musica.* The Polypary in all the species is purple-red; in the Indian species which PÉRON (*Voyage aux terres Australes* I. p. 146), and QUOY and GAIMARD (*Voyage de l'Uranie, Zoologie,* pp. 634—641 and Pl. 88) observed, the Polyps are green, in others they are whitish or light red, as in those which CHAMISSO described (*Nov. Act. Acad. Leop. Carol. N. C.* Tom. x. p. 370, Tab. XXXIII. fig. 2), and in *Tubipora rubeola* QUOY (*Voyage de l'Astrolabe, Zool.* IV. pp. 357—359), GUÉRIN *Iconographie, Zooph.* Pl. XXII. fig. 1, where the fin-like indents at the edge of the *tentacula* stand in a single row, as in *Tubip. Hemprichii* EHRENB., whilst in *Tubipora musica* EHRENB. to which FREYCINET'S plate quoted above refers, they form a double row.

To *Tubipora* fossil Polyparies appear to belong, *Catenipora* (*escharoides*) and *Syringopora* GOLDF. from the oldest limestone (mountain-lime).

Family VII. *Corticata.* Polypary fixed, ramose, its bark soft, supplied with calcareous spicula or granules, polypiferous, its axis hardish stony or horny. Polyps retractile, with tentacles having a single row of small conical appendages at the margin, gemmiparous and oviparous, conjoined by canals creeping through the bark.

The *barked-corals* (*corticifères*) of LAMARCK form a division very nearly allied to *Alcyonium* and *Pennatulina.* The polypary is here in its origin and mode of structure very different from that of the *Tubiporina,* but on the other hand resembles that of the *Pennatulina.* The hard axis, which alone is usually preserved in collections, may be compared with that of the *Pennatulina;* they are, in a word, fixed *Pennatulinæ.*

A. *Axis stony* (*Isidea* EHRENB.)

*Isis* L.

*Corallium* LAM. Shaft uniform, rigid, finely striated longitudinally.

Sp. *Corallium rubrum* LAM., *Isis nobilis* L. TOURNEF. *Instit. Rei herbariæ*, Tab. CCCXXXIX. (Axis), ESPER, *Pflanzenth. Isid.* Tab. VII, VIII.; CAVOLINI *Polipi*, pp. 32—47, Tab. II. CUVIER *R. Anim. édit. illustrée, Zooph.* Pl. 80. *Blood-coral;* in the Mediterranean, especially on the African coast. It is exported to the East Indies, and is also much used in Europe for neck-ornaments. It grows on all sorts of marine bodies, even on other corals, and not only downwards, but in all directions, increasing very slowly; it is seldom more than a foot long. The streaks visible on the unpolished axis are the impressions of vessels which run in the bark, and form a communication between the different polyps.

*Melitæa* LAM. Shaft knotty, genicula tumid, ramiferous.

Sp. *Melitæa ochracea, Isis ochracea* L., PALL., *Natuurl. Hist. der plantdieren*, door BODDAERT, Tab. VII. MEIJEN, *Reise um die Erde*, III. *Zool.* Tab. XXXIX. in the Indian Ocean.

*Isis* LAM. Shaft with jointed axis, nodes stony, striated, ramiferous, internodia horny.

Sp. *Isis hippuris* L.; ESPER *Pflanzenth. Isid.* Tab. I—III.

*Mopsea* LAMOUR., EHRENB. Shaft with jointed axis, nodes horny, ramiferous, internodia stony.

Sp. *Mopsea dichotoma, Isis dichotoma* L.; ESPER *Pflanzenth. Isid.* Tab. V.
Note. Here also belongs *Isis elongata*, ESPER *Pflanzenth. Isid.* Tab. VI, according to two specimens brought by the noble V. SIEBOLD from Japan, which are preserved in the Leyden Museum, and agree with ESPER'S figure. Is the same species also found in the Mediterranean, as PHILIPPI supposes, who refers to it *Mopsea Mediterranea* RISSO? See WIEGMANN u. ERICHSON'S *Archiv.* VIII. 1842. s. 38.

B. Axis horny (*Cerato-corallia* or *Gorgonia* EHRENB.)

*Gorgonia* L. (exclusive of species of *Antipathes*). Stem with axis horny, distinct: the crust polypiferous, fibroso-calcareous, persistent.

*Sea-shrub, Horn-plant.* These horn-plants grow with stem and branches upwards; the latter are usually situated in a plane, and often coalesce. Many earlier and later writers have believed the stem to be a plant, on which Polyps had fixed themselves. (*De natura vegetabili Gorgoniarum, auctore* G. L. C. GRAVENHORST, OKEN'S *Isis* 1823. s. 724. *Reale Academia delle scienze di Torino*

T. xxvi.) The species are very numerous, and many might perhaps by closer investigation be better defined. LAMOUROUX and EHRENBERG have formed different genera, which by the last especially have been distinguished by the arrangement of the Polyps.

Subgenera: *Prymnoa* LAMOUR., EHRENB. *Muricea* LAMOUR., EHRENB. *Eunicea* LAMOUR., EHRENB. *Plexaura* LAMOUR., EHRENB., *Gorgonia* LAMOUR., EHRENB., *Pterogorgia* EHRENB.—A new genus *Bebryce* PHILIPPI appears to be distinguished by non-retractile Polyps.

Sp. *Gorgonia flabellum* L., ELL. *Corall.* Pl. XXVI. fig. A—O. *Sea-fan, Mermaid's fan,* in different seas.

*Antipathes* PALL. (*Gorgoniæ* Spec. L.) Stem with axis horny, distinct, covered usually with minute spines, with bark polypiferous, gelatinous, deciduous.

*Sea-shrub.* The bark which is gelatinous, not calcareous or fibrous, is missing in specimens taken from the sea: hence, when preserved in collections, they resemble branches of dead wood.

EHRENBERG thinks *Antipathes* ought not to be joined to *Gorgonia,* and that it probably belongs to the *Bryozoa.* He refers to later communications, which have not yet, as far as I know, been published. (*Die Corallenthiere des rothen Meeres,* s. 113 in a note.) MILNE EDWARDS does not hold this opinion, LAMARCK *Hist. nat. des Ani. s. v.* II. p. 684. According to GRAY the Polyps of *Antipathes,* which he investigated in a specimen referred by him to *Ant. dichotoma* PALL. have *six* arms, but, with the exception of this strange anomaly, agree with those of *Gorgonia. Proceedings of the Zool. Soc. of London.* 1832. p. 41, 42.

Sp. *Antipathes spiralis* PALL., ESPER *Pflanzenth. Antip.* Tab. VIII., PALLAS *Plantdieren* by BODDAERT, Tab. VI. fig. 5.—*Antipath. myriophylla* PALL., ESPER l. l. Tab. X, GUÉRIN *Iconogr. Zoophyt.* Pl. XXIII. fig. 1. &c.

## ORDER III.

*Polyactinia* (*Zoocorallia polyactinia, Phytocorallia polyactinia,* and *Phytocorallia dodecactinia* EHRENBERG).

Polyps with twelve or more non-pinnate tentacles, simple or aggregate. Nutrient canal suspended in the cavity of the body, by means of lamellæ forming partitions. Aperture of the nutrient canal single, external, supplying the office of mouth and of anus.

## Section I.

Tentacles twelve. (*Phytocorallia dodecactinia* Ehrenb.)

Family VIII. *Madreporina* (*Madreporina* and *Milleporina* Ehrenb.) Polypary secreted by the Polyps, stony, supplied with polypiferous cells, usually ramose or expanded, lobate. Tentacles short.

*Madrepora* L. (exclusive of many species), Lam. (*Porites* Ejusd. *Heteropora* and *Madrepora* Ehrenb.) Polypary stony with cells circumscribed, lamellose, often prominent, with porous interstices.

Sp. *Madrepora palmata, Heteropora palmata* Ehrenb., *Madrepora muricata*, var. Esper *Pflanzenth. Madrepor.* Tab. li. On the animal of this species comp. Lesueur, *Mém. du Mus.* vi. pp. 290, 291, Pl. xvii. fig. 18. *Madrepora abrotanoïdes, Madrepora muricata* Pall., Quoy and Gaimard *Voyage de l'Uran.* Pl. xcvi., Guérin *Iconogr. Zooph.* Pl. xxiii. fig. 10.—*Madrepora pocillifera* Lam. &c.

*Pocillipora* Lam. Polypary stony, ramose, with cells of slight depth not lamellose, contiguous.

Sp. *Pocillipora damicornis* Lam., Esper *Pflanzenth., Madrep.* Tab. xlvi. and xlvi a. &c.

Genus *Nullipora* Lam. *Système des Ani. s. vertèbres* 1801. p. 374. (*Millepores* with pores not evident *Hist. nat. des Ani. s. vertèbres* ii. p. 341) according to Ehrenberg is in part to be brought here.

*Seriatopora* Lam. (in part). Polypary stony, ramose, with cells disposed in longitudinal rows, with margin slightly prominent. Polyps with the structure of the *dodecactinia*, destitute of tentacles.

Sp. *Seriatopora subulata, Millepora lineata* L., Esper *Pflanzenth. Millep.* Tab. xix.

*Millepora* L. (exclusive of species) Polypary stony, ramose, with cells deep, obsoletely or not at all lamellose, separate, scattered.

Sp. *Millepora alcicornis* L., Esper *Pflanzenth. Millep.* Tab. v, vii, xxvi, &c. (Here also the Polyps appear not always to possess arms). Many species which were formerly placed amongst the *Millepora* are now ranked in other genera.—*Millepora truncata*, the genus *Truncularia* Wiegmann (*Handb. der Zool.*), *Myriopora* Blainv. belongs to the *Bryozoa*, Ehrenb. *Die Corallenthiere des rothen Meeres*, ss. 126, 154, Milne Edwards in 2nd edition of Lamarck *Hist. Nat. des Ani. s. v.* p. 306.

## Section II.

Tentacles numerous, exceeding twelve.

A. Polyps secreting a stony Polypary, by which they are affixed (*Phytocorallia polyactinea* Ehrenb.)

Family IX. *Ocellina* Ehrenb. (and *Dædalina* ejusd. in part). Cells circumscribed.

Genera: *Caryophyllia* Lam., *Oculina* Lam., *Explanaria* Lam., *Cladocora* Hempr. and Ehrenb., *Anthophyllum* Schweigger, Ehrenb., *Astræa* Gm. (*Astrea* Lam.)

Sp. *Caryophyllia ramea* Lam., *Madrepora ramea* L., *Oculina ramea* Ehrenb., Tournefort *Instit. Rei herbariæ*, Tab. cccxl, *Madrepora*, Esper *Pflanzenth.*, *Madrepor.* Tab. ix. x a., Milne Edwards in Cuvier *R. Ani. éd. illustrée*, *Zooph.* Pl. lxxxiii. fig. 1, 1 a, 1 b (with the animals).—*Caryoph. calicularis*, *Cladocora calycularis* Ehrenb., Cavolini *Polipi marini.* Tab. iii, fig. 1—5, pp. 48—58, Milne Edwards in Cuv. *R. Ani. éd. illustrée.* Pl. lxxxiii. fig. 2.

*Note.* The too numerous genera in this family, severed from the genus *Madrepora* Linn., might perhaps be properly referred to two genera, *Oculina* and *Astræa*. Add *Monomyces* Ehrenb. with a solitary star.

Family X. *Gyrosa* (*Dædalina* Ehrenb. in part). Cells confluent into sinuous furrows, on both sides lamellose.

† *Stars concave.*

*Mæandrina* Lam. *Mæandra* Oken[1], Ehrenb. Polypary stony, hemispherical, on the convex surface stars winding, contiguous, lamellose.

Sp. *Mæandrina cerebriformis*, anglicè *Brain-stone*;—*Mæandr. labyrinthica*, *Mus. Besleriun.* 1716. Tab. xxvi. fig. 1, *Madrepore*, Savigny *Descr. de l'Egypte*, *Zoophyt.* Pl. v. fig. 4, &c. In this Polypary the confluent stars or cells (*ambulacra*), with their transverse plates, resemble the mountain-chains as usually engraved on geographical maps.

*Agaricia* Lam. Polypary foliaceo-lobate, on one side only furnished with furrows or stars in lamellæ.

Sp. *Agaricia elephanthotus* Ehrenb., Esper *Pflanzenth. Madrep.* Tab. xviii. &c.

*Pavonia* Lam. Polypary foliaceo-lobate, with leaves compressed, on both sides stelliferous.

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[1] *Lehrb. der Naturgesch.* iii. 1. s. 70. 1815.

Sp. *Pavonia agaricites, Madrepora agaricites* L., ESPER *Pflanzenth., Madrep.* Tab XX, CUV. *R. Ani. édit. illustr., Zooph.* Pl. LXXXIV. fig. 2;—*Pav. lactuca, Madrep. lactuca* PALL., ESPER *Pflanzenth., Madrep.* Tab. XXXIII. A, B, QUOY et GAIM. *Voyage de l'Astrolabe,* Pl. XVIII. fig. 1, copied in CUV. *R. Ani. éd. illustr., Zooph.* Pl. LXXXIV. fig. 1. The animal figured and described by QUOY and GAIMARD has round the mouth tubercles and no arms, is very flat, and resembles an *Actinia;* EHRENBERG places this species with *Mœandrina pectinata, Mœandr. areolata,* and some others under a new genus *Manicina.* The singularly flat and thin leaves of this Polypary have given occasion to the name of *Endive-Coral* (*lactuca*).

†† *Stars convex.*

*Monticularia* LAM.

B. Polyps secreting internally a hard body (Polypary stony, not affixed).

Family XI. *Fungina* EHRENB.

The stony polypary is here an internal induration of the animal, and is by EHRENBERG compared with the calcareous plate of Cephalopods (the back-bone of the *Sepia*).

*Fungina* LAM. Polypary free, orbiculate or oblong, hemispherical or conical, above convex and lamellose, with an oblong central lacuna or gap, below concave and rugged. Star single, occupying the upper surface with lamellæ denticulate or rough on the margin.

*Sea-mushroom.* The numerous plates, running from the center to the circumference, give this Polypary some resemblance to a mushroom, in which however the plates are situated beneath the cap. Some have an elongated form, and hence, in the names they bear, are compared to moles or slugs.

The *Fungiæ* lie in clefts of rocks and cavities of coral-reefs, surrounded by branched corals, so that the force of the current is broken whilst the access of sea-water is not precluded. The older specimens are quite free: but younger ones are seated on a stem, on rocks, or sometimes are fixed to the dead remains of other *Fungiæ;* in the pedunculate state they resemble the genus *Caryophyllia* LAM. The stem is at first hollow, and is afterwards filled with calcareous coral-substance; the disc becomes larger, and at last the stem entirely disappears. S. STUTCHBURY, *An Account of the Mode of Growth of Young Corals of the genus Fungia, Transact. of the Linnean Society of London,* vol. XVI. 3. p. 493—498. 1833.

In most the entire Polypary belongs to a single Polyp. In some species no tentacles or arms are distinguishable; but in others there are numerous thick, conical arms, irregularly scattered; in the middle the large, transverse oral aperture is seen. The animal surrounds the Polypary as well beneath as above. See the figure of *Fungia crassitentaculata* QUOY and GAIMARD, *Voyage de l'Astrolabe, Zooph.* Pl. XIV. f. 3, 4, also transferred into the illustrated edition of CUVIER, *R. Ani. Zoophytes*, Pl. LXXXII. fig. 1. GUÉRIN, *Iconogr. Zoophytes*, Pl. XXIII. fig. 6. In other species, according to the observations of ESCHSCHOLTZ, QUOY and GAIMARD and others, many animals are grown together; the oral apertures, here without tentacles, lie partly in the oblong median depression of the Polypary, partly between the plates. These form the genus *Polyphyllia* QUOY and GAIMARD, and *Herpolitha* ESCHSCH. (*Herpetolitha* LEUCK.), *Haliglossa* HEMPR. and EHRENB.

See on this genus F. S. LEUCKART, *Observat. Zool. de Zoophytis Coralliis, speciatim de genere Fungia. Cum Tabulis IV. æri incisis.* Friburgi Brisigavorum. 1841. 4to.

Sp. *Fungia agariciformis* LAM., *Madrepora fungites* L., *Mus. Beslerian.* Tab. XXVI. fig. 3. FORSK. *Icon. Rer. natural.* Tab. XLII., ESPER *Pflanzenth. Madrep.* Tab. I. LEUCKART l. l. Tab. IV. fig. 1—3, round, with fine toothed laminæ; the animal had been observed before by FORSKÅL, and varies in colour; QUOY and GAIMARD have figured it entirely red, if indeed their figure refers (as EHRENBERG concludes) to this species. *Voyage de l'Uranie, Zool.* Pl. XCVI. fig. 1, 2.—*Fungia limacina* LAM., *Haliglossa limacina* EHRENB., ESPER *Pflanzenth. Madrep.* Tab. LXIII.;—*Fungia talpa, Polyphyllia talpa*, &c.

Genus *Cyclolithas* (*Cyclolites* LAM.) Polypary stony, orbiculate, with center sub-lacunose (monostoma), above lamellose, with dichotomous lamellæ, beneath with plane surface, with concentric rings.

Fossil species from the oolitic and chalk formations, allied to *Fungiæ* with which GOLDFUSS joins them.

Sp. *Cycl. hemisphærica* LAM., BRONN *Urweltliche Pflanzenthiere* 1825, fol. Tab. V. fig. 11; *Cycl. cancellata* LAM., FAUJAS DE SAINT FOND, *Hist. nat. de la mont. de Saint Pierre*, Pl. XXXVIII. fig. 8, 9, &c.

*Turbinalia* (*Turbinolia* LAM.) EHRENB. Polypary conical, with base acuminate, cell single, terminal, lamelloso-stellate. (Is this its place?)

Sp. *Turbin. rubra* QUOY and GAIM. *Voyage de l'Astrolabe, Zool.* Tom. IV. p. 188, Pl. XIV. fig. 5—9. GUÉRIN, *Iconogr. Zoophyt.* Pl. XXIII. fig. 7, CUV. *R. Ani. éd. illustr., Zooph.* Pl. LXXXII. fig. 5. This species, drawn up at New Zealand from a depth of twenty-five fathoms, fastened to a shell, has

an animal much resembling an *Actinia*, with a large oval oral-aperture surrounded by numerous, very large, transparent tuberculated rays. The other species upon which LAMARCK has founded this genus are only known in the fossil state. It was thought that they were not affixed, and consequently they were referred to this family; the discovery, however, of the voyagers quoted above, shews that the species now living far rather belongs to the family of the *Ocellina*, and probably ought to be joined to *Monomyces* EHRENB. It may be suspected, perhaps, from STUTCHBURY'S observations, that here younger forms of *Fungia* have crept in.

To *Turbinalia* the genus *Diploctenium* GOLDFUSS, *Flabellum* LESSON may be added. See *Flabellum pavoninum* LESS. *Illustrations de Zool.* Pl. XIV.

*Note.* The genus *Lithactinia* LESSON related to the *Fungiæ*, might perhaps from recent investigations be established with propriety. Comp. LESSON *Illustrations de Zoologie*, Pl. VI.

C. Polyps with the whole body soft or subcoriaceous.

Family XII. *Zoanthina.* Polyps affixed, never detached spontaneously, rarely solitary, more frequently gregarious, gemmiparous or oviparous, never dividing spontaneously.

*Zoanthus* CUV. Bodies fleshy, subcylindrical, below slender, at the top clavate, gregarious, adhering by filiform gemmiferous stolons of the base. Mouth terminal, crowned with tentacles filiform or clavate.

Sp. *Zoanthus Ellisii, Actinia sociata* ELLIS, *Phil. Transact.* 57, Tab. XIX. fig. 1, 2. *Encyclop. méth.* Pl. LXX. fig. 1, GUÉRIN *Iconogr., Zooph.* Pl. XX. fig. 4. *Zoanth. Bertholetii* EHRENB., *Polythoa Bertholetii* AUDOUIN, SAVIGNY *Descr. de l'Egypte, Polypes*, Tab. II. fig. 3. *Zoanthus Couchii* JOHNSTON, *Hist. Br. Zooph.* p. 202. Pl. XXXV. fig. 9.

*Mamillifera* LESUEUR, *Cavolinia* SCHWEIGG. Bodies cylindrical or clavate, gregarious, conjoined by a membranous base, not retractile.

Sp. *Mammillifera Cavolinii, Madrepora denudata* CAVOLINII, *Polipi marini*, Tab. III. fig. 6—8, pp. 57, 58.

*Palythoa* LAMOUR., EHRENB., *Corticifera* LESUEUR. Bodies gregarious, connate, dilated into a coriaceous expansion, with the little apertures slightly emergent.

Sp. *Palythoa ocellata, Alcyonium ocellatum* ELLIS and SOL.

*Hughea* LAMOUR., EHRENB. Polyps solitary, oviparous, without any stolons.

Sp. *Hughea Savignyi, Palythoa Savignyi* AUDOUIN, *Descr. de l'Egypte, Polypes,* Tab. II. fig. 1.

Family XIII. *Actinina.* Polyps affixing themselves by the part opposite to the mouth, loosening spontaneously and creeping or swimming, solitary, oviparous or viviparous, never dividing spontaneously, rarely gemmiparous.

*Actinia* L. Body conical or cylindrical, with mouth at the top simple, surrounded by tentacles numerous, cylindrical, radiant in one or several rows, with base discoidal.

*Sea Anemonies.* Comp. on these animals, BASTER *Natuurkundige uitspanningen,* I. 1762, bl. 138—142; DICQUEMARE, *Essay towards the elucidating of the history of the Sea-anemonies, Philos. Transact.* 1773, p. 361, 1775, p. 207, 1777, p. 56; RAPP, *Ueber die Polypen im Algemeinen und die Actinien insbesondere,* 1829; A. A. BERTHOLD, *Zergliederung der see-anemonen und namentlich der* Actinia coriacea *in Beiträge zur Anatomie, Zootomie und Physiol.* Göttingen, 1831. 8vo. s. 1—19; J. F. BRANDT, *Prodromus Descriptionis Animalium ab* H. MERTENSIO *in orbis terrar. circumnavigatione observatorum* Fasc. I. Petropoli 1835, 4to. pp. 9—17 &c.

The Anemonies live on *Crustacea, conchifera* &c., swallow even occasionally large mussels, reject the shell, when the fleshy part has been extracted and consumed, by the mouth, and evert for this purpose their body, which they do likewise whenever they feel hunger. Their reproductive power is almost as great as that of Hydra; if they be divided transversely, new tentacles after a few weeks are seen on the inferior portion, and each half becomes a perfect creature; thus they may be propagated by fission, but propagation by spontaneous fission does not appear to occur naturally amongst *Actiniæ:* usually it is effected by *ova* which get into the stomach from the ovaries and are there developed; when the young ones come out of the egg they are rejected by the mouth. That the *actiniæ* are viviparous was formerly observed by BASTER. The young have at first fewer arms or tentacles than are afterwards present.

These animals, with their coronet of tentacles, resemble compound or double flowers; at the same time many also attract by their lively colours. Most of them are very sensitive of the stimulus of light, and the brighter the day spread their tentacles the more. Of *Actinea depressa* RAPP observed that it immediately contracted when sun-light fell upon it.

The cylindrical body is formed of a thick skin of which the innermost layer consists of longitudinal and transverse muscles. The tentacles are hollow. The stomach is a folded blind sac. The space between the stomach and the skin is divided by numerous partitions; the ovaries, whose efferent canals open into the base of the stomach, lie in the chambers thus formed[1].

*Actiniæ* are marine animals; they occur in the temperate and torrid zones. Some species are brought to market by the Italians and are eaten.

*A. With lateral pores* (*Cribrina* HEMPR. and EHRENB.)

Sp. *Actinia effœta* L., BASTER l. Tab. XIV. fig. 3, RAPP, l. l. Tab. II. fig. 2.—*Actinia coriacea* CUV., *Actinia senilis* L., BASTER l. Tab. XIII. fig. 2. RAPP, l. l. Tab. I. fig. 3, 4, LESSON *Illustr. de Zoologie*, Pl. LIV.

*B. Without lateral pores* (*Actinia* EHRENB.)

Sp. *Actinia viridis* GMEL., *Priapus viridis* FORSK. *Icon. Rer. natural.* Tab. XXVII. fig. B, b, *Actinia Cereus* RAPP, l. l. Tab. II. fig. 3; this species is eaten in the south of France, and is known by the name *Ortie* or *Ortigue*;—*Actinia tapetum* HEMPR. and EHRENB. with short and numerous *tentacula*; this species in the contracted state occasioned the establishment of a new genus, supposed to be distinguished by the absence of tentacles: *Discosoma* RUEPPEL and LEUCK., *Neue wirbellose Thiere des rothen Meeres*, Frankf. a. Main. 1828, Tab. I. fig. 1.[2]

*Actinodendron* QUOY and GAIMARD. Tentacles ramose (or provided with vesicles lateral, fasciculate, EHRENB.)

*Thalassianthus* RUEPP. and LEUCK., *Epicladia* EHRENB. Tentacles pectinate.

*Minyas* CUV. *Actinecta* LESS. Body free, globose, ribbed. Mouth surrounded by tentacles in many rows, which are sometimes lobate. Disc opposite the mouth supplied with aeriferous canals, serving to suspend the animal in water.

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[1] Besides the works of BERTHOLD and RAPP referred to, that of RYMER JONES, *General Outline of the Animal Kingdom and Manual of Comparative Anatomy*, London, 1841. pp. 39—44, also contains a detailed anatomy of *Actinia*.

[2] Comp. also the descriptions of several Mediterranean species of Actinia given by A. F. GRUBE, *Actinien, Echinodermen und Würmer des Adriatischen und Mittelmeers*, Königsberg, 1840, 4to.; amongst the new species is one remarkable for its change of colour, *Act. Chamæleon* GRUBE.

Sp. *Minyas cinerea* CUV. *R. Ani.* 1re edit. Pl. XV. fig. 8, LESSON *Centurie Zool.* Pl. LXII. fig. 1, in the Atlantic Ocean. This genus is referred by CUVIER to the *Echinodermata apoda;* LESUEUR, who has made known some other species of it, gives it a place near *Actinia.* An accidental, not a natural opening in the disc, opposite the mouth, was taken by CUVIER for *anus.* See the 2nd edition of LAMARCK, *Hist. nat. des Anim. sans vertèbres* III. pp. 427—429.

*Lucernaria* MUELL. Body gelatinous, radiate, the rays tentaculiferous at the tip, above flattish, with mouth central, funnel-shaped, protracted, below elongated into a pedicle disciform at the extremity.

Sp. *Lucernaria quadricornis Zool. danic.* Tab. XXXIX. JOHNSTON, *Hist. Br. Zooph.* pp. 244--252. fig. 3—7.

Comp. on this genus LAMOUROUX, *Mém. du Muséum,* II. pp. 460—471. Pl. XVI. Does it belong here? LAMARCK refers this genus to the *Acalephæ.*

*Edwardsia* QUATREF. Body free, cylindrical, rounded behind. The middle portion of the body with thicker epidermis, opaque; the anterior and posterior pellucid, retractile within the middle. Mouth furnished with tentacles, hollow, arranged in single or double row.

Sp. *Edwardsia Beautempsii* QUATREFAGES, *Ann. des Sc. nat. 2e Série.* Tom. XVIII. *Zool.* Pl. I. fig. 1, &c.

These remarkable animals, discovered by QUATREFAGES, live on the sea-shore in the sand, like *Sipunculus* and some Annulata. The tentacles are not perforate at the extremity, as little as they are so in *Actinia,* in which preceding authors (RAPP, RYMER JONES and others) admit a reception of water through the presumed apertures.

## ORDER IV. *Bryozoa.*

Nutrient canal supplied with double aperture (mouth and anus), replicate, the posterior portion ascending by the side of the anterior. Tentacles long, furnished with vibratile cilia, surrounding the mouth. The anterior part of the polyp soft, retractile within the posterior by inversion.

EHRENBERG was the first to separate with precision these animals from the other forms of the Polyps—see the Introduction to this class. MILNE EDWARDS makes of them, in company with the *Acephala nuda,* a division of the type of the *Mollusca* under the name of *Molluscoïdes.* As in our first order of Polyps we see a resemblance to *Acalephæ* or Medusæ, in the second recognise the proper type of the Polyps, and in the third perceive a transition to

the *Echinodermata*, so in this last order we cannot mistake the affinity to the *Mollusca;* this affinity is even so close that we hold the union of it with the Molluscs to be almost the more natural one.

Family XIV. *Stelmatopoda* nob. Tentacles disposed in a zone around the mouth.

A.) Cell (the posterior harder portion of the animal) covered by a moveable operculum. (Tentacles numerous, 16 or more.)

*Eschara* LAM. (Species of genus *Eschara* PALL., of *Millepora* L.) Polypary of aggregate cells substony, foliaceous, ramose. Both surfaces of the polypary covered with opposed cells.

*Crust-Coral.* Sp. *Eschara foliacea* LAM. (not PALL.) ELL. *Corall.* XXX. fig. a, A, B, C;—*Eschara cervicornis* LAM., CUV. *R. Ani. édit. ill., Zooph.* Pl. 86, &c.

Comp. on this genus MILNE EDWARDS, *Rech. anatomiques, physiol. et zool. sur les Eschares, Annal. des Sc. nat. 2e Série.* VI. 1836, *Zool.* pp. 5—53, Pl. I—V; *Observations sur les polypiers fossiles du genre Eschare,* ibid. pp. 321—345. Pl. IX—XII. These fossils occur partly in the chalk-formation, partly in the tertiary strata. M^c^COY, *Descrip. Brit. Palæoz. Foss. in the Geol. Mus. of the Univ. of Cambridge.* Camb. 1851. 4to. Pt. II. pp. 44—47. Pl. fig. 14—17.

*Melicerita* MILNE-EDWARDS. Fossil genus. Comp. *Ann. des Sc. nat. 2e Sér.* VI. *Zool.* pp. 345—347.

*Retepora* LAM. Polypary reticulato-ramose or perforated reticulately, calcareous. Cells of the Polyps situated on one side only of the polypary.

Sp. *Retepora cellulosa, Millepora cellulosa* L., ELL. *Corall.* Tab. XXV. fig. d, D, F; ESPER, *Pflanzenth., Millep.* Tab. I.; CAVOLINI, *Polipi marini.* Tab. III. fig. 12, 13. This polypary resembles a piece of fine lace, hence the french name *dentelle de mer* or *manchette de Neptune* (!)

*Adeona* LAMOUR., LAM. Polypary frondescent or fan-shaped, on both surfaces celluliferous, calcareous, supported by a stem subarticulate, not polypiferous.

Sp. *Adeona foliifera* LAM., SCHWEIGGER *Beob. auf naturh. Reis.* Tab. I; CUV. *R. Ani. édit. ill. Zooph.* Pl. 88, fig. 1;—*Adeona cribriformis* LAM., SCHWEIGGER l. l. Tab. II. fig. 5, CUV. l. l. fig. 2. In this species the stem bears a flattened expansion, perforated like a sieve or a net, from coalescence of the branches, and permanence of the intervening spaces.

Of this genus the Polyps, as far as I know, have not been observed, but it is placed here from the agreement of the Polypary; an idea may be formed of it by supposing an *Eschara* to be placed upon a jointed stem.

*Flustra* L. Polypary of aggregate cells, membranaceous, frondescent, lobate or expanded into a crust, celluliferous on one or both sides. The cells are often aculeate on the anterior margin, their opening transverse, semicircular, or lunate.

*Sea-Crust.* Sp. *Flustra foliacea* L., *Eschara foliacea* PALL., DE JUSSIEU *Mém. de l'Acad. royale des Sc.* Année 1742. Pl. IX. fig. 3; ELL. *Corall.* Pl. XXIX. fig. a, A, B, C, E; CUV. *R. Ani. édit. ill.* Pl. LXXVIII. fig. 1; JOHNSTON, *Hist. Br. Zooph.* pp. 342, 343. Pl. LXII. fig. 1, 2;—*Flustra cornuta* MILNE EDW., CUV. *R. Ani. édit. ill.* Pl. LXXVIII. l. l. fig. 2, &c.

*Eucratea* LAMOUR., (in part). MILNE EDW. *Ann. des Sc. nat.*, 2e *Série*, IX. *Zoolog.* pag. 204, Pl. VIII.

B.) Cell (the posterior harder part of the animal) without operculum; a setose collar or a crown of setæ in the anterior part of the body in many, or a muscular ring in others, in place of operculum.

*Tendra* NORDM.

Sp. *Tendra zostericola, Cellepora pontica* EICHW.

*Tubulipora.* Polypary calcareous made up of crowded tubular cells, parasitic or incrusting. Aperture of the cells orbicular. Tentacles 12.

Sp. *Tubulipora verrucosa* MILNE EDW., *Tubulipora orbiculus* LAM. (synonymes excluded); CUV. *R. Ani. édit. illustr., Zoophyt.* Pl. LXX. &c.

Comp. on this genus MILNE EDWARDS, *Ann. des Sc. nat.* 2e *Série*, VIII. *Zoologie* 1837. pp. 321—338. Pl. XXII—XXIV. JOHNSTON, *Hist. Br. Zooph.* pp. 265—274. Pl. XLVI. fig. 3, 4.

Subgen. *Diastopora* LAM.

*Cellularia* PALL., *Cellaria* LAM. Polypary ramose, composed of cells arranged in a single or double row or verticillate, tubular, calcareous, with orbicular aperture.

Sp. *Cellularia eburnea, Crisia eburnea* LAMOUR., *Sertularia eburnea* L., ELL. *Corall.* XXI. fig. a, A; CUV. *R. Ani. édit. ill. Zoophyt.* Pl. LXXIII. fig. 2; VAN BENEDEN, *Nouv. Mém. de l'Acad. de Brux.* XVIII. Pl. III. fig. 12—16, &c.

Comp. MILNE EDWARDS, *Mém. sur les Crisies, les Hornères et plusieurs autres polypes vivans ou fossiles dont l'organisation est analogue à celle des Tubulipores, Ann. des Sc. nat.* 2e *Série, Zoolog.* Tom. IX. 1838. pp. 193—238, Pl. VI—XVI; VAN BENEDEN, *Recherches sur les Bryozoaires, Nouv. Mém. de l'Acad. de Brux.* Tom. XVIII. 1845. pp. 11—29.

On the Polypary of this and some other genera shear-like organs are seen that have some resemblance to a bird's head; they have joints

which admit of motion like the jointed feet of *articulata*; their motions persist even when the animal has been for some time dead. Their use is not known. See figures in ELLIS *Corall.* Pl. xx. fig. 2 A. (of *Cellularia avicularia* LAM.: of *Flustra angustiloba* LAM.); comp. VAN BENEDEN *Recherches sur les Bryoz.* l. l. pp. 14—23, and NORDMANN and KROHN cited by SIEBOLD *Lehrb. der vergleich. Anat.* I. p. 33: also DARWIN *Voyages of Adventure and Beagle*, vol. III. pp. 259—62 quoted, with figures, by JOHNSTON, *Hist. Br. Zooph.* pp. 329—332.

*Valkeria* FLEMING, FARRE.

Sp. *Valkeria cuscuta, Sertularia cuscuta* L.; ELL. *Corall.* Pl. XIV, C, C. FARRE, *Phil. Trans.* 1837. Pl. XXIII.

*Vesicularia* THOMPSON, FARRE.

Sp. *Vesicularia spinosa, Sertularia spinosa* L.; ELL. *Corall.* Pl. XI. fig. 17 b, B, C, D; FARRE, l. l. Pl. XXII.

*Serialaria* LAM. Polypary horny, ramose, composed of cells cylindrical, parallel, cohering in rows.

Sp. *Serialaria lendigera, Sertul. lendigera* L.; ELL. *Corall.* Pl. XV. No. 24 b, B; CAVOLINI, *Polipi mar.* Pl. IX. fig. 1, 2; the cells stand close together, as in a Pan's-pipe. JOHNSTON, l. l. p. 369.

*Anguinaria* LAM. Cells elongate, subclavate, perforated by a lateral aperture, set on a creeping fistulous stolon, erect, distant.

Sp. *Anguinaria spatulata, Sertul. anguina* L.; ELL. *Corall.* Pl. XXII. fig. 2 c, C; LISTER *Phil. Trans.* 1834. Pl. XII. fig. 4; JOHNSTON, *Hist. Br. Zooph.* p. 290. Pl. L. fig. 8, 9.

*Bowerbankia* FARRE.

Sp. *Bowerbankia densa* FARRE, l. l. Tab. XXI. XXII.

*Laguncula* VAN BENEDEN, *Lagenella* FARRE.

Sp. *Laguncula repens* FARRE, l. l. Tab. XXIV.

*Note.* According to A. S. HASSALL *Bowerbankia densa* is a younger state of *Valkeria imbricata*; *Annals and Magaz. of nat. Hist.* VII. 1841, p. 363, 364. But in *Valkeria* and *Vesicularia* from the observations of FARRE and VAN BENEDEN there are 8 tentacles not spinous; in *Bowerbankia* and *Laguncula* 10—12 tentacles, besides vibratile cilia, supplied with immoveable setæ or spines.—*Lusia* MILNE EDW. (in a note to LAMARCK *Hist. nat. des Ani. s. vert.* 2e édit. II. p. 72) is it *Laguncula*?

*Halodactylus* FARRE. Polypary fleshy, gelatinous, pellucid. Polyp with tentacles 12—16, often longer on one side.

Sp. *Halodactylus diaphanus* FARRE, *Alcyon. gelatinosum* L., ELL. *Corall.* Pl. XXXII. fig. d, ESPER, *Pflanzenth. Alcyon.* Tab. XVIII., FARRE *Phil. Trans.* 1837. Pl. XXV, XXVI.; VAN BENEDEN *Rech. sur les Bryozoaires* l. l. Pl. v. fig. 1, 2; occurs on our coast (Dutch), adhering to marine plants and shells resembling a gelatinous, transparent, tubular, and irregularly branched sea-weed.

Family XV. *Lophopoda* DUMORTIER *s. Cristatellina.* Tentacles set pectinately on two arms, numerous.

*Cristatella* CUV. Polypary free, disciform, polypiferous on the margin.

Sp. *Cristatella mucedo* CUV., *Cristat. vagans* LAM., ROES. III. Suppl. Tab. XCI; in fresh water; three, four, or more Polyps are seated in a freely-swimming Polypary. GERVAIS and TURPIN have figured the egg, which is provided with tubular spines terminating in two or more hooks; it bursts into two valves, when the young animal is born. See *Ann. des Sc. nat. 2e Série,* VII. *Zool.* pp. 65—93. Pl. II. Pl. III. A. JOHNSTON, *Hist. Br. Zooph.* p. 389.

*Plumatella* nob. Polypary affixed, tubular, with extremities of tubules retractile, polypiferous.

*Plume-Polyps* (*Polypes à pannache* TREMB.) Comp. *Mémoire sur l'Anatomie et la Physiologie des Polypiers composés d'eau douce nommés Lophopodes,* par B. C. DUMORTIER. Tournay 1836. 8vo. (published in part at an earlier date in the *Bulletin de l'Acad. des Sc. de Bruxelles* 1835, p. 422 &c.) Propagation occurs by eggs and buds. TREMBLEY also observed spontaneous fission of the Polypary in *Plumatella cristata.*

*Plumatella* LAM. *Naisa* LAMOUR. Stem branched or lobate.

Sp. *Plumatella cristata* LAM.; TREMB. *Polyp.* Tab. x. f. 8, 9; the body transparent, 1‴ long, the plume nearly of the same length; about sixty tentacles; it lives in fresh water beneath Lemna.

*Plum. campanulata* LAM. ROES. *Ins.* T. III. *Suppl.* Tab. 73—75. (LINNÆUS united this species with the former, under the name of *Tubularia campanulata.*) Probably *Plumatella repens* LAM., SCHAEFFER *Armpolypen* 1754 (2nd edit. 1763). Tab. I. fig. 1, 2, EICHHORN *Wasserthiere.* 1781. Tab. IV. p. 43 (*der Polyp mit dem Federbusch*), is only a variety of this. According to NORDMANN, the tube continues to grow for some time after the death of the Polyp. When full-grown it has up to sixty tentacles, but in young animals they are less numerous, shorter and thicker.

*Fredericilla* GERVAIS.

Sp. *Plumatella sultana, Tubularia sultana* BLUMENB. *Handb. d. nat. Hist.* Pl. I. fig. 9.

*Alcyonella* LAM. Polypary incrusting, irregular, multiform, composed of tubules aggregate, cylindrical.

Sp. *Plumatella fungosa* nob., *Alcyonella stagnorum* LAM., *Encycl. méthod. Vers.* Pl. 472. fig. 3, a, b, c, d, RASPAIL *Hist. naturelle de l'Alcyonelle fluviatile, Mémoires de la Soc. d'Hist. nat. de Paris,* IV. 1828. pp. 75—130, pl. 12—16. To this species probably BAKER'S figure belongs, *Employment for the microscope,* Pl. XII. fig. 13—22 (*Bell-flower animal*). See JOHNSTON, *Hist. Br. Zooph.* pp. 391—395.

RASPAIL is of opinion that this animal is merely a form of *Plumatella campanulata* altered by age, from which he does not distinguish *Plumat. cristata;* as soon as the animal breaks the egg, it moves freely about, and should then be described as *Cristatella,* so that all of them belong to one and the same species at different periods of life. But amongst other objections to the union with *Plumatella cristata* and *campanulata* is the number of the tentacles which in *Alcyonella* is, according to RASPAIL, only forty-four (according to EHRENBERG forty-two), whilst here, if it were an older state of *Plumatella campanulata,* the number might rather be expected to be greater. Also in *Cristatella* there are more tentacles. However, it is possible that *Cristatella* may be a younger form of another species of *Plumatella,* and so at some future time to be excluded from the list of *genera.*

PALLAS, as it seems, first discovered the *Alcyonella* in our country in the well-known lake of Rockanje, in the island Voorn, and described it by the name of *Tubularia fungosa, Nov. Commentar. Acad. Scient. Petropol.* XII. 1768. The name *Alcyonella* should be rejected, for it was borrowed from a supposed resemblance with *Alcyonium,* which on further investigation was found to be totally unfounded.

VAN BENEDEN has observed the sexes to be distinct in *Alcyonella,* male and female individuals occurring in the same Polypary. *Bullet. de l'Acad. des Sc. de Brux.* Tom. VI. 1841. p. 276.

*Paludicella* GERVAIS.

Sp. *Alcyonella articulata* EHRENB. *Symbol.?* Comp. VAN BENEDEN *Bullet. de l'Acad. des Sc. de Bruxelles* VI. 1. 1.

## CLASS III.

### SEA-NETTLES (*ACALEPHÆ*)[1].

By *Sea-nettles* are understood radiate animals of a gelatinous, transparent substance, which swim freely, and of which the organisation in parts that are frequently repeated usually indicates the number four or its double. They have no intestinal canal, but ordinarily a blind stomach from which numerous tubes, mostly divided into branches, run like rays to the circumference of the body (aquiferous vessels, respiratory organs?). In some the sexes are separate: others appear to be bi-sexual. Traces of a nervous system are present at least in some; yet organs of sense, except appendages which serve for feeling, are absent in many, whilst some have in addition parts which by certain writers are considered to be organs of hearing, by others organs of sight.

Of the name *Sea-nettles*, *Acalephæ*, *Urticæ marinæ*, we have treated above. With LAMARCK they form an order of the class of radiate animals (*Radiaires*), under which this writer also groups

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[1] On this class may be compared especially:

F. ESCHSCHOLTZ, *System der Acalephen*, Mit 16 Kupfertafeln. Berlin, 1829, 4to.

C. G. EHRENBERG, *Die Acalephen des rothen Meeres und der Organismus der Medusen der Ostsee.* Mit 8 colorirte Kupfertafeln. (Reprinted from the *Physikal. Abhandl. der Königl. Akad. der Wissenchaften zu Berlin aus dem Jahre* 1835).

*Histoire naturelle des Zoophytes. Acalèphes par* R. P. LESSON, av. pl. Paris, 1843, 8vo.

J. G. WILL, *Horæ Tergestinæ, oder Beschreibung und Anatomie der im Herbste* 1843 *bei Triest beobachteten Akalephen.* Mit 2 Tafeln, Leipzig, 1844.

EDW. FORBES, *A Monograph of the British Naked-eyed Medusæ, with figures of all the species.* London, printed for the Ray Society, 1848, fol.

HUXLEY, *On the affinities of the Medusæ. Phil. Transact.* London, 1849, Pt. II. p. 413 &c.

On the *Siphonophoræ:*

A. KOELLIKER, *Die Schwimmpolypen, oder Siphonophoren von Messina.* Mit 12 Tafeln, Leipzig, 1853, fol.

R. LEUCKART, *Die Siphonophoren, eine Zoologische Untersuchung,* Giessen, 1853, 4to.

R. LEUCKART, *Zur nähern Kenntniss der Siphonophoren von Nizza,* Mit 3 Kupfertaf. Berlin, 1854, 8vo.

C. VOGT, *Sur les Siphonophores de la Mèr de Nice.* Genève, 1854.

those with a spiny skin (*Echinodermata*) as a second order[1]. They were first described as a distinct class of animals by CUVIER in the first edition of the *Règne Animal*, under the name of *Acalephæ*[2].

The name of gelatinous animals is more appropriate to this class than to some others of the Radiates of CUVIER. The kinds most generally known bear the name of Zeekwallen in Holland, [Quallen in Germany, Squalders[3] or sea-jelly or sea-blubber in England.] When thrown by the sea upon the strand, they lie motionless during the ebb; for they do not creep, but can only move in the water by contraction and expansion.

The pungent and burning pain like that caused by stinging nettles, which many species inflict on being touched, was generally considered in former times to be the effect of a mucus secreted by the skin of these creatures. It is only since 1841, from WAGNER'S microscopic investigations, that minute threads situated on the surface of the skin have been recognised as connected with this phænomenon, since in Acalephes which cause no such pain (as in *Cassiopea*) they were not discovered. Each of these threads lies rolled up in a little oval vesicle or cell, from which, on pressure or irritation of the skin, it is forced out by eversion; they are readily detached with the vesicle to which they are fixed by a tubercle, and are always present in the secreted mucus that produces a burning pain. Yet the cause of this ought not to be considered as entirely mechanical; it is probable that some acrid fluid, secreted by the cells, adheres to the threads[4]. Nevertheless an accomplished

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[1] *Radiaires mollasses*, LAMARCK *Syst. des anim. s. vertèbres*, 1801, pp. 341, 352, and in his later works, *Extrait du Cours de Zoologie sur les anim. s. v.* 1812, and *Hist. Nat. des Anim. s. vert.* 1815.

[2] CUVIER in his *Tableau élémentaire* (1798) and in the tables at the end of the first part of his *Leçons d'Anat. comp.* had comprised all the animals, which he afterwards named radiated animals, in a single class, under the name of *Zoophytes*. Of this the *Orties de Mer* make the second order, which agrees with his later class of the *Acalephæ*. Here also he placed the *Actiniæ*, which however in the second edition of his *Règne Animal* he separated from it again, in order to unite them, as had already been done by others, with the Polyps.

[3] [SIR T. BROWNE'S Works edited by WILKINS, Vol. IV. p. 333, quoted by FORBES *Brit. Starf.* p. 87.]

[4] R. WAGNER *über muthmassliche Nesselorgane der Medusen*, WIEGMANN u. ERICHSON *Archiv. f. Naturg.* 1841, I. s. 38—42; *Ueber den Bau der Pelagia noctiluca*. Leipsig, 1841, fol. *Icon. Zoot.* Tab. XXXIII.—Subsequently these parts were also investigated by EHRENBERG, PHILIPPI, WILL, MILNE EDWARDS &c.

observer, Dr. F. WILL, found these threads in *Eucharis* (amongst the *Beroëeea*) without perceiving any irritation on touching it.

In many there is only a single oral aperture, placed in the center on the inferior surface of the body. In others many suctorial tentacles are seen, or the arms have apertures conducting to tubes, which, like vessels, fall into larger stems and finally open into a common cavity, the stomach (*Rhizostoma* CUV.). From the stomach arise water-canals, which are provided internally with cilia. By some writers these have been regarded as blood-vessels: but far rather ought they to be considered as respiratory organs, since in part they open freely on the surface of the body. But, in addition, blood-vessels have been found, which, at least in *Beroë*[1], lie round about the water-canals, surrounding them like a sheath. Here nucleated corpuscles have been observed (blood-corpuscles?) which however move only very slowly and irregularly.

The sexual organs are distinct in the disciform Acalephes, but have in both sexes the same form. In *Æquorea* they lie in form of folded plates on each side of the water-canals which spring from the stomach, towards the inferior surface of the disc. In the eared Medusa (*Aurelia* or *Medusa aurita*) there are four cavities, opening below at the disc and which have been taken for respiratory cavities, in which lies a folded organ, that is, an ovary or a testis, according as it contains ova or spermatozoa; in most Acalephes the spermatozoa have the ordinary cercarial form. In other Acalephes, as *Beroë*, ovaries and testes are united in the same individual: here they lie along what are called the ribs, beneath the skin.

The metamorphoses, of which we have already spoken above, are remarkable in young *Medusæ*. The eggs, that pass from the ovaries along the canal of the arms to their folds, are collected here and carried about, for a time, by the mother in saccules which afterwards disappear[2]. The young animals quit these receptacles in the form of ciliated Infusories resembling *Leucophrys* or *Bursaria*. These swim freely about, but after a short time (two or three days according to SIEBOLD) become fixed by their thicker anterior extremity which has a sucker. Next, the body becomes cylindrical, transparent, and at the free end, which thickens, an oral aperture is

[1] [The blood-vessels described by WILL could not be seen by FORBES, HUXLEY, LEUCKART, &c.]

[2] See the figures of EHRENBERG *Die Akalephen* &c. Tab. III. fig. 1. 2. Tab. VIII. fig. 1.

seen, round which at first two, then other two projections appear that become lengthened out into arms. Soon there grow out four other similar arms, and the animal has then the form of an eight-armed Polyp. These arms can shorten and lengthen themselves greatly. In this state the animal continues several months, and can multiply itself by buds and offsets. Subsequently there come into view transverse indentations, by which the animal is divided into several rings resting upon one another, round each of which eight rays arise. These rings are like young medusæ piled on one another: they become separated from each other, from before backward; and then swim freely away as young medusæ[1]. How long a period is requisite for their full growth is unknown. The genital organs could not be distinguished until they were more than an inch in size. Hence it is clearly an error when some ascribe to these creatures in general a very short duration of life and a rapid growth—or even name them annual animals. Their power of reproduction seems to be very small. Some species are able to bear the loss of parts, but these when removed do not continue to grow. In the genus *Cestum*, however, MERTENS was led to believe, from some observations which he was unable to complete, that propagation by spontaneous division may be admitted. [And this has been lately confirmed by KOELLIKER[2], in *Stomobrachium mirabile*, which he believes to be a larval form of *Mesonema cœrulescens*, a new species of *Medusa* discovered by him at Messina. The fission begins in the stomach—many individuals having been found with their round disc somewhat elongated and with two stomachs more or less completely separate by constriction, but still lying side by side. Next, a meridional groove is seen on the outside of the disc between the stomachs: it deepens gradually until the acaleph is separated into two distinct individuals. The whole process may be completed in eight to twelve hours. The multiplication however is not yet

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[1] SARS *Beskrivelser og Jagttagelser* &c. (extract from it in WIEGMANN'S *Archiv.* 1836, s. 197 &c.); and in WIEGM. *Archiv.* 1837, B. II. s. 406; C. T. VON SIEBOLD *Beiträge zur Naturgesch. der wirbellosen Thiere*, Dantzig, 1839, 4to. s. 26—35. SARS in WIEGMANN and ERICHSON'S *Archiv.* 1841, s. 9—34. *Mémoire sur le développement de la Medusa aurita et de la Cyanœa capillata, Ann. des sc. nat.* sec. série XVI. *Zoologie*, pp. 321—348, Pl. 15 A—17. 1841. J. STEENSTRUP *Om Fortplantning og Udvikling gjennem vexlende Generationsräkker*, Kjöbenhavn, 1842, 4to.

[2] SIEBOLD and KOELLIKER'S *Zeitschrift f. wissenschaft. Zool.* IV. pp. 325, 327.

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finished: the halves again divide in a direction perpendicular to the former line of division: but here the fission does not always begin in the stomach. How often the process may be repeated is not known. No trace of fission was observed in *Mesonema*, though it was often seen to occur in the larval forms, even when ova were already distinctly visible on the vessels.]

[The *Siphonophoræ* have been shewn, by the investigations of HUXLEY, LEUCKART, KOELLIKER, GEGENBAUER and VOGT, to be compound animals, or colonies, connecting the hydroid polyps with the acalephs. They are named by KOELLIKER, in consequence, Swimming Polyps (*polypi nechalei*). They consist in general of a stem, usually cylindrical and long (*Diphyes*), sometimes shortened and sacciform (*Physalia*), sometimes disciform (*Velella*), to which appendages are attached which differ remarkably in form and function. Some of these are suctorial tubes or stomachs, others motive organs, others feelers and prehensile organs, others again protective laminæ (bracts) and sexual capsules. Great differences prevail with respect to the number, arrangement, and development of these parts, in the different families: those which are constant in all siphonophors are the stomachs, the prehensile apparatus, and the sexual capsules. The stem is muscular, and hollow—the interior forming a canal in which the nutrient fluid moves with rapidity. The swimming apparatus is either passive or active—when passive it is a hydrostatic apparatus consisting of a bladder filled with air which is always placed at the upper extremity of the common stem: when active it consists of swimming-bells, which are also placed at the upper extremity of the stem, and are variously grouped, and in variable number in different genera: the swimming-bells may exist conjointly with the air-sac or without it. These bells are, in general, formed on the plan of a Medusa, consisting of an elastic bell-shaped mantle, very various in form, with an internal muscular layer which surrounds the swimming-sac. On the outer surface of the latter, there is a system of four radiating vessels, which, at the circumference of the aperture, fall into a circular vessel, and at the summit of the bell arise from a single vessel, which passes through the pedicle of the bell and falls into the cavity of the common stem. All the other appendages of the stem have also a more or less perfect system of vessels, which communicate with the internal cavity of the stem in a similar way. The only communications

from without with the cavity of the stem are by the mouths of the digestive tubes, which answer to the bodies of polyps. The food digested by these stomachal polyps is conveyed from their extremity into the cavity of the stem, from whence it is carried through the vessels of all the appendages, partly by the contractility of the walls of the stem, partly by the action of the cilia which line the vessels of the appendages.

The polyps, or suctorial tubes, or stomachs, have no tentacles round the mouth. They consist of three portions; the external, very variable in form, the proboscis and mouth: the middle swollen portion, the digestive stomach, with dark streaks containing bile-cells: the terminal rounded portion, with thick cellular walls. At the base of the stomach, or sometimes immediately on the common stem, is the prehensile apparatus for the capture of prey. This usually consists, for each polyp, of a single long and thin thread with lateral subdivisions, which do not branch; more rarely of simple threads or shorter cylinders. This apparatus is always supplied with multitudes of thread-cells, which in the case of lateral accessories are grouped in very regular and constant forms, and are conspicuous from their bright yellow colour. The sexual appendages have large swimming bells of the general medusan form. They consist of a bell-shaped mantle and vessels—and a nucleus, more or less conspicuous, which contains in its substance the sexual elements, and is dependent from the vertex like the clapper of a bell. In some cases the medusan form of the mantle is in great measure suppressed, whilst in others it is quite complete, and here the sexual appendage is detached at an early period, as in certain hydroid polyps, and the sexual elements are developed afterwards: where the medusan form is not thus perfect, the contents of the sexual capsules, when detached, are found to be mature. The *Diphyidæ* are, according to LEUCKART, all uni-sexual, but the observations of GEGENBAUER (*Zeitschr. f. wissensch. Zool.* v. p. 313) shew that some at least have the organs of different sexes on different groups of the same stem: the *Physophoridæ* are all bi-sexual, in some (*Stephanomia*) the organs of the two sexes being on different pedicles, in others (*Physalia*) on the same pedicle.

The organs of less general occurrence are the Bracts, Laminæ or Covers, and the Feelers. The Bracts or Covers, more solid than the other organs, are for their protection: they contribute little

to the motion of the colony, but sway gently to and fro with the contractions of the stem. The Feelers are cylindrical or vermiform structures having much resemblance to the polyps, but without an external opening. In some cases they are in constant motion, feeling about in all directions: in others they are more sluggish and are loaded with the general nutrient fluid. The latter fact would seem to suggest a respiratory function. Some writers have considered them to be receptacles for the fluid forced from the interior of the prehensile apparatus during its violent contractions: and hence the name, sometimes given to them, of fluid-holders. But it has been objected to this explanation, that the two sets of organs are often at great distances from each other, and that their alternate action has not been established.

The composition of all the organs in the Siphonophors corresponds to that of the other acalephs. As in these, the specific gravity of the mass differs little from that of sea-water. The shell found in some families, (*velella, porpita*) is the thickened and hardened wall of the air-sac[1].]

On the Nervous System of Acalephs, the observations are hitherto imperfect. In the *Medusæ* EHRENBERG observed, at the base of each of the eight marginal corpuscles which he takes to be eyes, a part which he considers to be a ganglion. Each of these ganglia is double, or consists of two limbs that diverge towards the marginal corpuscle. Besides these a row of ganglia lies near the tentacles at the margin of the disc; every ganglion divides into two twigs, each of them for one of two adjoining tentacles: so that every tentacle receives two nervous twigs coming from different ganglia. This ring of ganglia round the margin is interrupted by the larger double ganglia of the marginal corpuscles. Moreover, EHRENBERG saw four groups of ganglia lying in the cavities for the four genital organs and in connexion with the tentacles of these cavities. EHRENBERG could not detect a nervous ring round the mouth, the usual form of the nervous system in Radials[2]. Some writers are of opinion that it by no means follows from these observations that the parts so described are really nerves. GRANT described in *Cydippe pileus* a nervous ring with eight ganglia, each

[1] Comp. LEUCKART *Zoologische Untersuchungen*, s. 3—41; KOELLIKER *in Zeit. f. Wissensch. Zool.* IV. s. 306—315.

[2] EHRENBERG *Die Akalephen* &c. s. 25, 26.

giving off three nerves, of which the largest ran lengthwise between two bands of cilia[1] close to the external surface of the body; but a later observer, F. WILL, was not so fortunate as to find this system of nerves. On the contrary he detected a conical ganglion above the funnel-shaped structure from whence the water-canals arise, consequently opposite to the mouth. From this ganglion many fine threads arise, to be distributed to the substance of the body and its different parts. In the same situation MILNE EDWARDS also saw a ganglion in the genus *Lesueuria*, from which numerous nerves, collected into four bundles, arose[2].

EHRENBERG considers the eight prominent organs, situated in *Medusæ* at the edge of the disc, to be eyes: they contain a sandy or stony concrement, a quantity of minute hexagonal prismatic crystals composed of carbonate of lime. Such calcareous concrements are often found in the animal organism in the neighbourhood of nerves; as for instance in Frogs by the sides of the vertebral column near the exit of the spinal nerves. A red pigment which moreover generally distinguishes these marginal corpuscles, (it is sometimes wanting,) caused EHRENBERG to conjecture that they were eyes[3]. There is more probability in KOELLIKER'S idea, that they are to be considered as auditory organs[4]. Even in vertebrates little stones or grit of carbonate of lime are found in the auditory sac or vestibule of the membranous Labyrinth. In *Beroë* and the allied genera only a single organ of the sort is found, a pedunculated vesicle with calcareous crystals at that end of the body which is opposite to the mouth[5].

The apparatus for motion consists of transparent muscular fibres, having sometimes a longitudinal, sometimes a circular course: they exhibit the same microscopic transverse stripes which are characteristic of the voluntary muscles of higher creatures[6].

Several of the Animals belonging to this Class are phosphorescent. According to EHRENBERG the Arabians on the Red Sea

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[1] *Trans. of the Zoolog. Soc.* London, I. 1833, p. 10.

[2] *Ann. des sc. nat.* 2e Série, Tom. XVI. *Zoolog.* p. 206.

[3] *Die Akalephen*, s. 14.

[4] FRORIEP'S *Neue Notizen*, XXV. Bd. (Januar. 1843) s. 81—84.

[5] MILNE EDWARDS, l. l., WILL, *Horæ Tergest.* s. 45, 46.

[6] WAGNER *Bau der Pelagia noctiluca;* his *Tab. Zoot.* XXXIII. fig. 30; WILL, l. l. s. 46—49.

name the entire family of Medusæ *Sea-Candles* (*Kandil el Bahr*[1]). Bosc, and other writers after him, went too far when they maintained that all *Medusæ*, nay all Acalephes (Eschscholtz) are phosphorescent. Still, not Medusæ alone, but other Acalephes also do possess this property: the phænomenon has been observed in species of *Beroë* (*Cydippe pileus*, *Eucharis multicornis*, &c.): *Stephanomia* also diffuses a lively light by night. This phosphorescence is a vital phænomenon, and ceases on the death of the animals: though some of them, like other organic substances, are luminous even after death; but that light is of a different nature from phosphorescence during life. Thus Will, for instance, saw *Beroë rufescens* emit a light after death, which differed by its bluish-green colour from the yellowish-red irradiations of the living animal. Dead *Acalephæ*, or mucus arising from decomposition of animal substances, can contribute little or nothing to the gorgeous spectacle of the illumination of the sea, of which so many voyagers have given striking descriptions: the chief cause of the brilliant sparks resides in minute marine animals, especially *Medusæ*, like the species which Suriray named *Noctiluca miliaris*, and which, being not larger than a pin's head, looks like a globule of mucus to the naked eye[2].

Acalephes are met with in all seas. A very large number of species occur in the Mediterranean belonging to the most different forms. In the seas of the cold and temperate zones scarcely any *Siphonophoræ* are found, at least not in the northern hemisphere; however the currents may occasionally bring with them southern forms from a distance, as is proved by the fact that Owen, on the south-west coast of England, observed *Velella* and *Porpita*, and Hyndman, on the coast of Ireland, *Diphyes*[3]. Some species are widely diffused, as *Aurelia aurita*, and *Cyanœa capillata:* the first was

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[1] Ehrenberg *das Leuchten des Meeres*, s. 146. Comp. especially on this subject the work already quoted p. 53, so instructive as well from the author's own observations as from the extensive use he has made of earlier works.

[2] [Van Beneden refers *Noctiluca miliaris* not to the Acalephes but rather to the *Rhizopoda;* see note by Dr Schlegel in the german translation of this work, p. 106.]

[3] Owen *Lectures on the comp. Anat. of the invertebr. Animals*, 1843, p. 102; Hyndman *Note on the occurrence of the Genus Diphya on the coast of Ireland, Ann. of Nat. Hist.* vii. 1841. p. 164.

found by EHRENBERG in the Red Sea, and he could not discover any difference between it and that found in the northern and the Baltic seas. Oftentimes many species of Medusæ are collected in such quantities at certain places, that they form as it were banks in the sea, which it requires days to sail through[1]. In fine calm weather *Medusæ* come to the surface: during storms they seek the quieter waters of the depths.

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[1] PÉRON *et* LESUEUR *Annales du Mus.* XIV. p. 222; such a bank of *Medusa aurita* in the Baltic at the mouth of the Weichsel was also described by V. SIEBOLD, *Beitr. z. Naturgesch. der wirbellosen Thiere*, s. 5.

# SYSTEMATIC

# ARRANGEMENT OF ACALEPHÆ.

## CLASS III.

### ACALEPHÆ.

GELATINOUS animals, swimming freely. Stomach included in the parenchyme of the body, without an abdominal cavity; canals arising from the stomach, filled with water. Ovaries and testes in one and the same individual or the sexes distinct without organs of copulation. Vestiges of a nervous system not always distinct. Arrangement of parts usually quaternarian.

### ORDER I. *Siphonophoræ.*

[Swimming Polyps without tentacles round the mouth, attached to a common stem of variable length, and moving freely by means of special swimming apparatus, with prehensile filaments, feelers, and protective covers or bracts, or some only of these organs, attached mediately or immediately to the same common stem.]

This first order includes the *Acalèphes hydrostatiques* of CUVIER and a part of his *Acalèphes simples.*

Family I. *Velellidæ* or *Chondrophoræ.* Common body, supported by a cartilaginous[1] lamina, which is cellular internally.

The part of the body which faces upward is supported by a disc, which in *Porpita* is even in some degree calcareous, and con-

[1 The disc contains horny substance, not cartilage, according to LEUCKART.]

tains cells which are full of air. Above, this disc is covered by the integument alone; below, it sustains all the parts of which the [compound] animal consists.

[The shell of *Velella* with its horizontal and perpendicular plates consists of a single piece. The thicker horizontal portion is formed of two laminæ connected by perpendicular concentric pieces, so that annular canals are formed which are filled with air. These canals communicate with each other in *Velella*, but not in *Porpita:* in both they open externally by many minute pores on the upper surface. The soft parts constitute a mantle which covers the shell and projects beyond its edge by a free border. At the inferior excavated portion of the shell, the mantle has on its outside the attached polyps and appendages, on the inside the large liver.

The polyps are of two sorts, a single large and central polyp, and many small ones disposed around it in irregular rows. They have been designated "stomachs" and "suctorial tubes." But observers do not agree respecting their function. LESSON attributes to both sets a digestive power, *Voyage de la Coquille*, pp. 49—56, and *Acalèphes* p. 561 : whilst V. SIEBOLD *Vergl. Anat.* s. 63, note, thinks that the smaller polyps alone discharge the office of digestion, and consigns the large one to the respiratory system : and HOLLARD *Ann. des Sc. Nat.* T. III. 1845, p. 250, says that the large central pouch is the stomach and the small ones *canaux aquifères.* KOELLIKER however assures us that he has found small *crustacea* both in the large and the small tubes, and has seen the residue of digestion pass from them all indifferently. Consequently we conclude with him and others, that the *Velellidæ* are colonies or compound animals.

The liver is a large brownish mass placed above the central stomach : it fills the inferior cavity of the horizontal plate. It is a collection of fine canals formed of homogeneous membrane lined with brown cells. A certain number of the canals branch from two openings in the base of the central polyp : they frequently anastomose and form a network on the surface of the liver from which fine vessels pass to the perpendicular plate and to the margin of the horizontal plate (*Velella*). These vessels, then, would seem to have received the nutriment which has passed from the central stomach into the liver-canals, for the purpose of redistribution to the soft parts when it has been modified by the biliary secretion. Of the smaller polyps a few, which hang beneath that part of the liver which projects beyond the large polyp, open into liver-canals: but the

greater part of them have no connexion with these canals, or with the central polyp, but lateral branches of the vessels open into their pedicles, so that they at once give the product of digestion to the vascular system. In *Porpita* the lesser polyps open into liver-canals and not into vessels.

The generative organs are seated, as clusters of minute bodies, on the pedicles of the smaller polyps. They become transparent and pyramidal, and having gradually assumed the medusan form are detached. They were first noticed by DELLE CHIAJE, *Descriz.* IV. p. 107, Tav. 146, fig. 10, 12. The sexual germs are formed on the wall of the radiating vessels. HUXLEY, GEGENBAUER, l. l.

The prehensive organs are placed around the lesser polyps on the horizontal margin of the mantle. They are hollow and open into a vessel like the lesser polyps. They have no special nettle-nodes, but numerous scattered thread-cells.

The air-canals were discovered by KROHN; they are minute vessels which pass from the innermost air-spaces of the horizontal cartilage, perforate the mass of the liver, and reach the walls of the polyps where they appear to terminate by closed extremities. They are most numerous in *Porpita*. See KOELLIKER *Die Siphonoph.* pp. 46—64.]

*Velella* LAM. A semi-orbicular crest, compressed, containing a cartilage within, placed obliquely above the disc. Marginal tentacles simple.

Sp. *Velella spirans, Medusa velella* L., *Holoth. spirans* FORSK. *Icon. Rer. natur.* Tab. XXVI. fig. k, *Armenistarium velella* COSTA *Ann. des Sc. nat.* sec. série, Tom. XVI. Pl. 13, fig. 3, (figure of the vessels from the stomachs on the inferior surface of the cartilaginous disc), in the Mediterranean. According to FORSKÅL the French sailors call the animal *Vallette:* they eat it fried with flour and butter. The name *Velella* appears to be derived from *velum* and from the crest, which like a full-spread sail, adorns the upper surface. The beautiful blue colour of the animal is imparted to the water in which it is examined, but disappears in spirit of wine. During life the creature is not unattractive (*"non invenusta est quantum vermi licet,"* FORSK. *Descr. Animal.* p. 105); see the coloured figure of LESUEUR in PÉRON, *Voyage aux terres austr.* Pl. XXX. fig. 6. (This species is from the Tropical Seas, *Velella scaphidia* PÉRON). For the other species, not easily to be distinguished, of this genus, consult chiefly ESCHSCHOLTZ *Syst. der Acalephen*, s. 168—175.

Subgen. *Rotaria* ESCHSCH. Crest membranous, placed longitudinally on the disc.

*Note.* If the figures in FORSKÅL, Tab. XXVI. fig. k 3, k 4, k 5, belong to a *young Velella*, as appears from the explanation of the plate, this genus must be suppressed; which is BLAINVILLE'S opinion.

*Porpita* LAM. The Lamina cartilaginous (?), circular, marked with concentric striæ decussated radially. Marginal tentacles appendiculate.

Sp. *Porpita mediterranea* ESCHSCH., *Porp. Forskalii*, DE HAAN, *Hol. denudata* FORSK. *Icon. Rer. nat.* Tab. XXVI. fig. L., in the Mediterranean;—*Porp. umbella* ESCHSCH., *Porp. gigantea* PÉRON, *Voy. aux terres austr.* Pl. XXXI. fig. 6, in the Tropical Seas; *Porp. chrysocoma* LESS., GUERIN *Iconogr., Zoophytes*, Pl. XVIII. f. 2.—(*Medusa Porpita* L. is merely the cartilaginous disc of some species of this genus.)

Family II. *Physsophoridæ* (*Hydrostatica* CUV.) Body suspended in the water by means of a swim-bladder or of receptacles filled with air.

*Bladder-bearers.* The opinion that these animals are able to expel the air from the air-bladder at will was rendered doubtful, as a general rule, by OLFERS, who could find no opening in the large bladder of *Physalia*. [Subsequent observations however have determined that *Physalia* is the only one of the *Physsophoridæ* whose bladder does really communicate with the external air. But, though there be no such communication in the rest, LEUCKART states that in many of them (and he believes it to be true of all) the air may be readily caused to pass from the cavity of the bladder into that of the common stem, by the expansion of the upper extremity of which the air-bladder is in all cases surrounded.

*a*) with short stem or axis without swimming bells.

*Physalia* LAM. Swimming bladder very large, crested above, with an aperture at one extremity: the whole of the common stem expanded so as to form a receptacle for it: from the inferior surface of the expanded stem the polyps are suspended together with feelers and prehensile organs, of different thickness and of great length.]

*Sea-bladder.* The colony swims constantly on the surface of the sea, and for that purpose makes use of the crest on the top of the bladder as a sail. Hence its name, *het bezaantje, the Portuguese man of war, la petite galère*, &c. If in the nomenclature we ought strictly to hold to priority, then this genus ought to be named

*Salacia*, for thus LINNÆUS announced it in the earlier editions of his *Syst. Nat.*; in the tenth and following editions it is no longer met with, and LINNÆUS afterwards arranged the species known to him under the genus *Holothuria*.

VON OLFERS especially threw much light upon the organisation of this genus by the investigation of *Physalia caravella* ESCHSCH. (*Phys. arethusa* TILES.) A *Physalia* has two bladders, the internal is filled with air, and was described by OLFERS as perfectly closed; the external has an aperture situated at one extremity and surrounded by a sphincter.

[QUATREFAGES has described the action of this sphincter muscle, and the connexion of both bladders with the aperture; he also caused the air contained in the interior bladder to be analysed, and found that it contained less of oxygen than atmospheric air by about 3 per cent.: the animal appeared to be able to expel the air voluntarily at intervals, and to distend the bladder again after a short time: it would therefore seem to be a respiratory organ for the colony: the air-bladder is surrounded on all sides by the external bladder or envelope, which is in fact the expanded stem of the colony: with the under surface of this the various appendages are connected, and into its cavity the cavities of them all open more or less directly: the bladder in *Physalia* did not appear to QUATREFAGES[1] to be merely a passive organ, for besides the power of emptying and distending it the animal seemed to be able to direct the fluid contained in the cavity of the appendages into this or that bundle of them at will, and so to alter the position of the center of gravity of the bladder, and by thus bringing different regions of it to the surface to steer its course.]

The larger and smaller tentacles are capable of extension and contraction, and serve probably for feeling and seizing. Small clumps of red corpuscles, which are situated between the larger tentacles, are, according to OLFERS, eggs: but the sexual organs of the *Physsophoridæ* require further investigation.

See v. OLFERS in *Physikal. Abhandl. der Königl. Akademie der Wissensch. zu Berlin a. d. Jahre* 1831, Berlin 1832, s. 155—200.

Comp. also on this genus J. C. VAN HASSELT *in Algem. Kunst. en Letterbode* 1828, No. 44, 45; F. W. EYSENHARDT, *Nov. Act. Acad. Cæs. Leop.*

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[1] *Ann. des Sc. nat.* 3e Série, Tom. II. p. 115.

*Carol.* Tom. x. s. 410—416, Tab. xxxv. fig. 42; ESCHSCHOLTZ in O. v. KOTZEBUE'S *Entdeckungs-reise* III. 1821, s. 193, and *Syst. der Acalephen*, s. 157—164. LEUCKART *in Zeitschr. für Wiessensch. Zoologie* III. 189—213.

*Athorybia* ESCHSCH. (*Rhodophysa* BLAINV.) [The motor organ of the colony a coronet of solid bracts, or covers, fixed to the stem immediately beneath the air-bladder. Polyps, feelers and prehensile filaments attached to the very short remainder of the stem.

Sp. *Athorybia rosacea* ESCHSCH. KOELLIKER *Die Siphonoph.* Tab. VII. The Polyps are not nearly as numerous as the bracts. In large colonies KOELLIKER could not count more than eight of them whilst the bracts numbered 20—40. They are seated in the space covered by the bracts, and with their points project somewhat beyond them when the coronet opens, but lie entirely concealed when it closes. The feelers are more numerous than the polyps (11—20), long and nearly filiform, and play between the bracts when they open. The lateral subdivisions of the prehensile organs terminate by two filaments.

*b)* with short axis or stem and swimming bells.

*Physsophora* FORSK. Several swimming bells disposed verticillately round the common stem. The polyps with feelers and prehensile organs, but without bracts (GEGENBAUER), attached to the remainder of the stem immediately below the swimming column.]

*Physsophora* (from φύσα or φύσσα), literally *bladder-bearer*, was compared by FORSKAEL to the so-called Cartesian Imp (*situs animalis hydrostaticus sublatus pulmone extra corpus, ad formam machinæ quam Diabolum Cartesianum appellamus*). *Descr. Animal.* p. 112.

Sp. *Physsophora hydrostatica* FORSK. *Icon. Rer. nat.*, Tab. XXXIII. fig. E, in the Mediterranean; *Physsoph. muzonema* PÉRON, *Voy. aux terres australes*, Pl. 29, fig. 4; LESSON *Acalèphes*, Pl. 9, fig. 2, in the Atlantic, &c.

The species are not sufficiently distinguished; FORSKAEL figured an imperfect specimen, which for the most part had lost the suctorial tubes and other appendages. The figure given by PHILIPPI not long ago represents the animal in an uninjured state; this writer supposes that the specimen found by him in the Mediterranean belongs to another species, which he names *Physsophora tetrasticha*. There are four rows of swimming bells, and in each row four. See his Memoir in MUELLER'S *Archiv.* 1843, s. 58—67, Taf. v. [KOELLIKER states that this of PHILIPPI is identical with the *Physsophora rosacea* of DELLA CHAIJA, *Descr. degli anim. invertebr.* IV. pag. 119, Tav. 33, fig. 2.]

[See KOELLIKER's description of a new species (l. l. p. 19, Tab. v.) found by him at Messina, and which he calls *Physs. Philippi.* The type of *Physsophora* is distinguished by the very small length of the axis below the swimming column. The column is as usual terminated by a small bladder above the bells filled with air. Beneath it the polyps, feelers, prehensile and sexual organs are all compressed into a small space. The feelers surround the axis immediately beneath the bells in a continuous coronet, like the calyx of a flower. They are described by KOELLIKER as exceedingly sensitive, in constant motion, and even laying hold of prey. Within the circlet of feelers arise the Polyps, each with its prehensile filament. The néttle-node has an exceptional formation. There are no bracts or covers, their protective office being supplied by the near neighbourhood of the swimming column. The sexual organs are seated in bunches on the stem close to the Polyps, a pair of different sex at the base of every Polyp.

### *c*) with long axis without swimming bells.

*Rhizophysa* PÉRON. No swimming bells: the polyps with their prehensile organs lateral, usually secund: bracts and feelers wanting.

Sp, *Rhizophysa Peronii* ESCHSCH. *Acal.* Taf. XIII. fig. 3. *Rhizophysa filiformis* LAM., *Zeitschrift für wissensch. Zoologie,* v. s. 324—330. Taf. XVIII. fig. 5—11.

### *d*) with long axis or stem and swimming bells at the upper part of the common stem.

*Stephanomia* PÉRON, ESCHSCH. Swimming bells numerous, forming a conical column which surrounds the stem with many spiral turns. Polyps set on the stem by a long, slender, contractile pedicle. Feelers pediculate affixed to the stem, usually in threes between two successive Polyps. Bracts or covers not confined to the stem, but also surrounding the base of the Polyps as the calyx a flower. Prehensile filaments very long with lateral branches at regular intervals bearing a node and terminating in a single thread. Sexual organs in bunches close set on the feelers from the stem.

The *Stephanomia uvaria* of LESUEUR does not, according to KOELLIKER, differ from *Apolemia* ESCHSCH.

In a specimen of *Stephanomia* four feet in length LEUCKART counted no less than 20 spiral turns in the swimming column, with 10—12 bells in each turn. The three feelers from the stem are two on a common pedicle and one sessile. The male and female organs

are in close proximity to each other at the base of the double feelers. The male are the least numerous, the form oval, slightly medusan, the nucleus as it ripens passing from red to yellow: there are four radial canals and a circular canal, the mantle lying close to the nucleus and having an opening. The female appendages are smaller and round, but of similar structure, except that the central vessel of the nucleus is not developed, for each appendage contains only a single egg. Compare the interesting observations and figures of MILNE EDWARDS *Ann. des Sc. Nat.* 2e Série Tom. XVI. *Zool.* pp. 217—229, Pl. 7—10. Also *R. Anim.* CUV. *éd. illustr. Zooph.* Pl. 59. See LEUCKART *Zoolog. Untersuch. Erster Heft.* s. 38.

*Forskalia* KOELLIKER.

Sp. *Forskalia Edwardsii* KOELL. This new genus and species differs little, if at all, from *Stephanomia* according to LEUCKART. See the description and beautiful figures in KOELLIKER *Die Siphonophoren v. Messina*, s. 2—10. Taf. I. II.

*Agalmopsis* SARS. Swimming column formed of two rows of bells alternating. Below it, the stem gives origin to single Polyps, feelers, prehensile filaments and sexual organs with numerous transparent bracts or covers.

Sp. *Agalmopsis elegans* SARS, *Fauna littor. Norvegiæ* I. p. 36, Tab. V. fig. 7, 8. The prehensile filaments give off branches which again subdivide to terminate in two threads: a contractile bladder is seated below the point of last division, and immediately before this is a spiral nettle-node covered by a bell-shaped duplicature from the filament on which it is placed. *Agalmopsis punctata* KOELL., a new species, differs from the last in the branches of the prehensile organs having the node without a cover, and in terminating without further division: also the feelers have special prehensile organs which are knotted.

*Agalma* ESCHSCH. Swimming column with bells in two rows: feelers scattered. Polyps with bracts and prehensile organs of which the lateral branches are provided with a large nettle-node and subdivide to terminate in two threads having a contractile vesicle between them at the division.]

Sp. *Agalma Okeni* ESCHSCH. *Isis* XVI. 1825, Tab. 5, *Syst. der Acaleph.* p. 151, Tab. XIII. fig. 1.

[*Apolemia* ESCHSCH. Swimming column composed of two rows of bells of quadrangular form with rounded angles. Feelers from two to four set on the stem between successive pairs of bells.

Polyps numerous, sessile, prehensile organs with simply spiral nettle-nodes. Bracts claviform with special prehensile organs small, knotted. At regular distances below the swimming column a collection of polyps with all these appendages surround the stem.

*Note.*—In no other genus of *Physsophoridæ* are feelers met with on the part of the stem which supports the swimming bells.

*Stephanomia uvaria* LESSON belongs to this genus: KOELLIKER, *Die Schwimmpolypen*, s. 18. See GEGENBAUER'S description of a complete specimen of it, and figure, *Zeitschrift für wissensch. Zool.* v. s. 319—324. Pl. XVIII. fig. 1.

Family III. *Hippopodidæ.* Colonies of swimming Polyps, without swimming bladder, with short common stem, the swimming column not formed of bells.

*Hippopodius* QUOY and GAIM. ESCHSCH. The swimming column formed of bracts in two rows, and covering one another imbricately, with filiform short stem, to which the polyps with their prehensive and sexual organs are attached.

Sp. *Hippop. luteus, Ann. des Sc. nat.* x. 1827, s. 172, 173, Pl. IV. A. GUERIN *Iconogr., Zooph.* Pl. XIX. fig. 4.—*Hippopod. neapolitanus* KOELL. *Die Siphon.* pp. 28—31. Tab. VI. figs. 1—5.

*Vogtia* KOELL.

Sp. *Vogtia pentacantha* KOELL. *Die Siph. von Messina*, s. 31, 32. Tab. VIII.

Family IV. *Diphyidæ.* Locomotive apparatus of the colony two distinct cartilagineo-gelatinous transparent pieces affixed to the upper part of a thin cylindrical common stem. The stem beginning in the substance of the anterior piece passes in a groove of the posterior between the two, and then gives attachment to groups consisting of a single polyp and its appendages.]

This family includes certain marine animals, transparent as glass, which swim by means of the contraction of hollow organs filled with water; it has the genus *Diphyes* for its type, which was first formed by CUVIER in the first edition of his *Règne Animal*, IV. p. 61. This genus rested on a species discovered by BORY DE SAINT-VINCENT at the beginning of this century (1801), in the South Atlantic Ocean, and described under the name of *Salpa bipartita;* see his *Voyage dans les quatre principales îles des Mers d'Afrique*,

I. 1804, p. 134, Pl. VI. fig. 3, A, B, C. The two pieces provided with swimming cavities, nearly similar in form, were afterwards, by CUVIER (*Règne Anim. sec. éd.* III. p. 288) and other writers, erroneously taken to be two animals which had become attached to each other, an opinion occasioned by observing that they were readily separated. This separation, or spontaneous detachment of different parts, has often been remarked in the entire order—as in *Physsophora, Rhizophysa, Stephanomia.* In fact, *Diphyes* is much more nearly allied to these genera than might be suspected from many, and sometimes very confused, descriptions of it. I may remark, that the part which, in our description, we have indicated as anterior, is called posterior by the first discoverer, BORY, and by many others after him.

QUOY and GAIMARD, who discovered many new species of this family and formed new *genera* from them, (*Ann. des Sc. nat.* Tom. x. 1827, p. 5—21,) determined subsequently to bring them all under the single genus *Diphyes,* (*Voyage de découvertes de l'Astrolabe, Zoolog.* Tom. IV. 1833, p. 81). [But more accurate observations of late years have shewn that this proceeding is not advisable. In *Praya* the swimming bells are similar in form, and are placed, more or less, side by side, and their cavities open on opposite sides of the stem. In *Diphyes* the bells are placed behind one another and open backwards.

The common stem begins within the substance of the anterior bell, or piece, in a more expanded portion, which is lined with large epithelial cells, and has very different form in different genera. This expanded portion often contains a globule of oily matter. Beneath it the stem gives origin to the canals of the swimming pieces, and then is prolonged to become the common axis of the colony.

The polyps with their different appendages are fixed to the stem at regular intervals. Those nearest to the swimming pieces are quite undeveloped and without appendages. Those at the other extremity of the stem are the oldest and most perfect, and have their appendages most complete. Each group consists of a Polyp, a set of prehensile organs, and the generative organ, which partakes more or less of the medusan form—the whole being covered by a protecting bract. Such a group either persists in adhering to the common stem, (*Diphyes, Praya*), and then only certain parts are detached, as the medusiform capsules of the sexual organs; or it is

capable, to a certain degree, of independent existence, and when fully developed, separates itself from the stem of the colony (*Abyla*). In the *Prayidæ*, the covers are bounded by round surfaces above, and have a cavity below, like a helmet, to receive the other members of the group: in *Diphyes* they surround the stem like a rolled leaf, (differing, however, in form in the different species) and adhere to it by the narrow part. In *Abyla* they cover the members of the group imperfectly, are almost solid, yet with a cavity in the interior which is in connexion with that of the stem, and which is lined by large cells. In all these groups the sexual buds are more or less medusiform, and may be developed into a swimming bell. They sprout from the base of the Polyp.]

Comp. on this family, besides the above work of QUOY and GAIMARD, especially ESCHSCHOLTZ, *Syst. der Akalephen*, s. 122, 123, LEUCKART *Zoologische Untersuchungen*, I. s. 41—49, KOELLIKER *Die Schwimmpolyp.* s. 36—46: also WILL, *Horæ Tergestinæ*, s. 76—83, GEGENBAUER in *Zeitschr. f. wiss. zool.* V. s. 297—300.

[*Diphyes* CUV. The posterior swimming piece received into a cavity of the anterior: the groups on the common stem protected by a bract or cover in form of a rolled leaf.

Sp. *Diphyes angustata* ESCHSCH. Tab. XII. fig. 6 (the species of BORY seems to belong here;)—*Diph. campanulifera* ESCHSCH., QUOY and GAIMARD *Ann. des Sc. nat.* X. 1827, Pl. I.; *Diph. gracilis* GEGENBAUER *Zeitschr. für wissensch. Zoologie*, V. s. 309—315. Taf. XVI. fig. 5—7.—*Diph. Sieboldei* KOELL. *Die Siphon. v. Messina*, s. 36—41. Taf. XI. fig. 1—8.—*Diph. gracilis* GEGENB. *Zeitschr. f. w. Zool.* V. s. 313—315. Taf. XVI. fig. 5—7.—*Diph. Kochii* WILL *Hor. Tergest.* Tab. II. f. 22—26; figured without the posterior portion which WILL did not meet with in any one of the six specimens examined by him[1].

*Abyla* ESCHSCH. QUOY and GAIMARD (*Calpe* of the same). The two swimming bells of very different size, the anterior much the smaller. The bracts cover the members of the groups imperfectly, are massive, and have a cavity communicating with the stem.

Sp. *Abyla pentagona* ESCHSCH., KOELLIKER *Die Siph. v. Mess.* s. 41—46, Tab. X.; here the single polyps have no covers: see a complete specimen described and figured in LEUCKART *Zool. Untersuch.*, I. s. 56—61, Taf. III. fig. 1—10. The bracts, or covers, which are not visible on the polyps at

[1] Compare also on this genus LESSON *Centurie Zoologique*, 1830, p. 161—183, Pl. 55—57.

the upper part of the stem, undergo remarkable metamorphoses after their first appearance as buds until they attain the cubical form, when the group of which it forms a part exactly resembles a young *Eudoxia cuboides*, QUOY and GAIM. See also GEGENBAUER *Zeitsch. fur wiss. Zool.* v. s. 292—295.

*Praya* LESSON. The two swimming pieces of the colony nearly similar and equal, the covers of the developed groups bounded by round surfaces above and concave beneath.

Sp. *Praya diphyes* LESS., KOELLIKER *Die Siphon. von Mess.* s. 33—36, Taf. IX.—*Praya maxima* GEGENB. *Zeitsch. f. wissensch. Zool.* v. s. 301—309, Taf. XVII. fig. 1—6.

The genera *Eudoxia*, *Ersœa*, *Aglaisma* ESCHSCH., which have only a single polyp, have been termed monogastric *diphyidæ* by HUXLEY; but it is almost certain that they are not independent genera. It has been noted above, when treating of *Abyla pentagona*, that a single group of this compound *diphyes* exactly resembles *Eudoxia cuboides;* and here the groups have been seen to detach themselves from the colony both by LEUCKART and by GEGENBAUER—as indeed the same fact had previously been observed by SARS in his *Diphyes truncata*. *Eudoxia campanulata* is believed by LEUCKART to be a group of *Diph. acuminata*, a new species observed by him at Nice; whilst he has found that *Aglaisma pentagonum* is not a monogastric *diphyes*, but an imperfectly developed *Abyla pentagona*, see *Zoologisch. Untersuch.* s. 54. *Ersœa* is suspected by LEUCKART to be a detached group of *Diphyes Koch.* WILL.

*Eudoxia* (&c.) consists of a cover or bract, a polyp with its prehensile organs, a swimming bell (sexual capsule), and usually a smaller bell sprouting from the base of the polyp, which is destined to replace the larger when this has been detached. These parts are all connected by their canals to a portion of common stem.]

Sp. *Ersœa pyramidalis* WILL, i. l. fig. 27, &c.;—Comp. LEUCKART *Zool. Untersuch.* I. s. 43—61, GEGENBAUER *Zeitsch. f. wiss. Zool.* v. 285—296.

## ORDER II. *Ctenophoræ*, or *Beroëcea*.

Mouth simple, stomach situated in the axis of the body. Vibratile cilia disposed in rows on the surface of the body. Swimming bladders none.

The Beroëcious animals are Acalephs of very different form, which, however, are distinguished from the former order by the absence of swimming bladders [bells] and cartilaginous laminæ, as

well as suctorial mouths: [they are single animals, in short, and not colonies.] The projecting edges, usually named ribs (*costæ*) which are beset with cilia, especially characterise this family: whence the German name *Rippenquallen*. Whether these vibratile cilia, which occasionally are so arranged as to form vibrating laminæ, do really cause the progression of these animals, as is usually assumed, is in consequence of the objections raised by MERTENS and by WILL (*Horæ Tergest.* s. 8—13) exceedingly doubtful.

The name *Beroë* given by BROWN (*Nat. Hist. of Jamaica*) to the animal discovered by him in the middle of the last century, is borrowed from Mythology; it is that of one of the numerous daughters of *Oceanus*:

*Clioque et Beroë soror, Oceanitides ambo.—*
VIRGIL, *Georgic.* Lib. IV. 341.

Comp. on this order: RANG, *Établissement de la Famille des Béroïdes et description de deux genres nouveaux qui lui appartiennent; Mémoires de la Soc. d'Hist. nat. de Paris*, Tom. IV. 1828, pp. 166—173, Pl. 19, 20. MERTENS *Beobachtungen und Untersuchungen über die beroeartigen Acalephen, Mém. de l'Acad. imp. des sc. de St. Petersbourg, sc. physiq.* sixième série, Tom. II. 1838, pp. 479—543, Taf. I.—XIII. (A copious extract may be found in OKEN'S *Isis*, 1836, s. 311—321.) LESSON, *Mém. sur la famille des Béroïdes, Ann. des Sc. nat.* 2e série, Tom. VI. *Zool.* 1836, pp. 235—266.

Family V. *Beroidea.* (The characters of the order are those of the single family.)

*A*) Stomach small.

*Cestum* LESUEUR. Body transverse, elongate, gelatinous, with ciliated margins.

Sp. *Cestum Veneris* LESUEUR *Nouv. Bullet. de la soc. philom.* Juin, 1813, Pl. V. (Recus. in OKEN'S *Isis*, 1817, s. 1505—1508, Tab. XII.) GUÉRIN, *Iconogr. Zooph.* Pl. 18, fig. 1. (after a drawing by LAURILLARD) in the Mediterranean. This *girdle of Venus* has the form of a band of more than five feet long, and full two inches high. In the thinner inferior edge is situated the oral aperture (opposite to the place assigned to it by LESUEUR in the thicker superior edge). In *Cestum Najadis* ESCHSCH. *Acal.* Tab. I. fig. 1, from the South-Sea, near the Line, two long *tentacula* beset with fine threads are present, which in the species from the Mediterranean are often, and in *Cestum Amphitrites* MERTENS (l. l. Tab. I.) are (always?) wanting.

The genus *Lemniscus* QUOY and GAIM. is probably founded on a detached piece of *Cestum*.

*Callianira* PÉRON. Body lobate or supplied with lateral wings.

Subgenera: *Eucharis* ESCHSCH., *Leucothea* MERTENS, *Mnemia* ESCH. (*Alcinoë* RANG), *Lesueuria* MILNE EDW., *Calymma* ESCHSCH. (*Ocyroë* RANG), *Callianira* PÉRON, ESCHSCH.

In bringing these numerous genera together, and giving greater extension to the name *Callianira*, than has been done by former writers, my sole object is to facilitate the review, and at the same time to indicate the affinity of these animals. Beyond doubt the genera are too numerous here. The genus *Bucephalon* of LESSON (*Callianira bucephalon* REYNAUD, LESS. *Centur. zool.* Pl. 28) also belongs here, and probably does not differ from *Calymma Trevirani*.

Sp. *Callianira hexagona* ESCHSCH., *Callian. Slabberi* DE HAAN, *Natuurkundige Bijdragen* II. 1827, pp. 150—152; this species has been confounded with *Beroë hexagonus* of BRUGUIÈRES (found at Madagascar). In the genus *Callianira* proper, there are two filiform branched tentacles; the other subgenera have mostly four conical or triangular ciliated tentacles.

*Cydippe* ESCHSCH. (*Beroë* FREMINVILLE, MERTENS.) Body globose or ovate, with eight longitudinal, ciliated ribs. Tentacles two, retractile within two subcutaneous vesicles.

Sp. *Cydippe pileus*, *Beroë pileus* MUELL., *Volvox bicaudatus* L.; L. TH. GRONOVIUS in *Uitgezochte Verhandelingen* Amsterd. 1758, III. p. 464, Pl. 26, f. 1—5; BASTER *Natuurk. Uitsp.* I. Pl. XIV. fig. VI. VII.; CUV. *R. Ani. éd. ill., Zooph.* Pl. 56, fig. 2, &c. (Since the vesicles, in which the tentacles lie, open towards that extremity of the body which is opposite to the mouth, the nervous ring (?) described by GRANT, cannot surround the mouth, (see above, p. 104). The tentacles are able to lengthen themselves greatly; why ESCHSCHOLTZ describes them as *indivisa*, is not apparent; at least in most species they are much divided.

*B*) Stomach large. A circle of vessels (aqueducts) round the oral aperture.

*Beroë* ESCHSCH. (spec. of the genus *Beroë* GRONOV., MUELL. and others) *Idya* FREMINV., OKEN, MERTENS. Body oval, ribbed, with large circular aperture beneath.

Sp. *Beroë ovata* BROWN, *nat. Hist. of Jamaica*, Pl. XIV. fig. 2; (this animal was the first named Beroë; LINNÆUS named it in the tenth edit. of the *Syst. Nat.*, *Medusa Beroë*, in the twelfth (1767) *Volvox Beroë*);—*Beroë Forskälii*, *Medusa Beroë Forsk.*, MILNE EDW. *Ann. des sc. nat.* 2° série, Tom. XVI. *Zool.* Pl. 5, 6; CUV. *Règne Anim. éd. illustr., Zooph.* Pl. 56, fig. 1, &c.

## Order III. *Discophoræ.*

Body disciform or campanulate, above naked, below usually provided with arms or tentacles.

The *Medusoïds* or *Sea-blubber.* They have a gelatinous disc, on the upper surface more or less spherical, which from its form has been compared to an umbrella or a hood; the form has some resemblance to toad-stools (*agarici*). These animals move themselves by expansion and contraction of the hood. The mouth, or the suctorial organs which take the place of the mouth, are situated in the center of the inferior surface, sometimes elongated into a pedicle and provided with different tentacles. On this difference are founded the numerous genera which modern writers have felt justified in adopting.

Compare on this order: Péron et Lesueur, *Tableau des caractères génériques et spécifiques de toutes les espèces de Méduses connues jusqu'à ce jour. Annal. du Muséum* xiv. 1809, pp. 325—366.

J. F. Brandt, *Ausführliche Beschreibung der von* C. H. Mertens *auf seiner Weltumsegelung beobachteten Schirmquallen; mit* 34 *meist colorirten Tafeln.* St Petersburg, 1838, 4to (from the *Mém. de l'Acad. des Sc. de St. Petersburg,* vi^e^. Série, Tom. iv.)

*A*) Many oscules.

Family VI. *Geryonidæ.* A peduncle from the center of the inferior surface of the disciform body, with the free extremity lobate, or furnished with arms. The border of the body mostly tentaculate. (*Genus Dianœa* Lam.)

It is not so completely established that all the forms here brought together are really characterised by the absence of a simple mouth. Will at least, in the animals placed by him in the genus *Geryonia*, found a mouth surrounded by four lobes. In some the pedicle is supplied at its extremity with a folded appendage (*Geryonia*), in others at its base, or at its extremity, it is beset with threads: *Favonia, Lymnorea,* &c.

Genera: *Geryonia* Péron, *Proboscidactyla* Brandt, *Dianœa, Linuche* Eschsch., *Saphenia* Eschsch., *Eirene* Eschsch., *Limnorœa* Péron, *Favonia* Péron.

Sp. *Geryonia proboscidalis, Medusa proboscidalis* FORSK. *Icon. rer. nat.* Tab. 36, fig. 1; GUÉRIN *Iconogr., Zooph.* Pl. 16, fig. 2; CUVIER, *R. Anim., édit. illustr., Zooph.*, Pl. 52, fig. 3. This species from the Mediterranean, with six threads or tentacles at the margin of the disc, may be considered as the *type* of this division.

Family VII. *Rhizostomidæ.* Arms ramose, with many suctorial oscules. Margin of the body without tentacles. Disc with four *ovaria* or *testes*, sometimes (in *Cassiopea*) eight.

*Rhizostoma* CUV. Tentacles amongst the arms none; arms confluent into one pedicle inserted in the disc.

Sp. *Rhizostoma Cuvierii*, RÉAUMUR *Mém. de l'Acad. des sc. de Paris*, 1710, Pl. XI. fig. 27, 28; CUVIER *Journ. de Physique* Tom. XLIX. p. 436; CUV. *R. Anim. édit. ill. Zooph.* Pl. 49. This species sometimes attains to a great size. The *Rhizostoma* has four pairs of suctorial arms, which are provided with absorbent vessels; by these it receives its nutriment, which consequently consists of minute animalcules, or of animal matters in solution. These absorbent vessels and their branches coalesce into four stems, which run along the pedicle and end in the stomach. From the stomach run laterally vessels through the hood. Surrounding the stomach are four cavities, with very wide opening below, in which the organs of propagation are seated. The uppermost portion of the hood consists of a substance more firm than the rest of the body. See K. W. EYSENHARDT, *Zür Anatomie und Naturgeschichte der Quallen, Nov. Act. Acad. Cæs. Leop. Carol. Nat. Curios.* T. X. pp. 375, &c. with figures. *Rhizostoma Aldrovandi* PÉRON, GUÉRIN *Iconogr., Zooph.* Pl. 15, fig. 1, &c.

*Cassiopea* PÉRON. Tentacles amongst the arms none. Arms eight or ten, very much branched, not conjoined at the base into a peduncle, furnished with vesicular appendages.

Sp. *Cassiopea frondosa, Medusa frondosa* PALL., *Spic. Zool.* X. Tab. II. fig. 1—3; *Cassiopea borbonica* DELLE CHIAJE, *Mémorie sulla storia e notomia degli Animali senza vertebre del Regno di Napoli*, I. 1823. Tab. III.; GUÉRIN *Icon. Zooph.*, Pl. 15, fig. 2; CUV. *R. Anim. édit. illustr., Zooph.* Pl. 51, fig. 2, &c. (See other figures of TILESIUS *Nov. Act. Acad. Cæs. Leop. Car. Natur. Curios.* Tom. XV. 2. 1831, pp. 247—288, Tab. 69—73.

*Cephea* PÉRON. Large cirri amongst the arms.

Sp. *Cephea cyclophora* PÉRON. *Medusa cephea* FORSK. *Icon. rer. nat.* Tab. XXIX. fig. (copied in CUV. *R. Anim. édit. illustr., Zooph.* Pl. 51, fig. 4) &c.

*B*) Mouth single central.

Family VIII. *Medusidea.* Mouth tetragonal central. Arms four, mostly very distinct, very rarely none. Four lateral cavities in the disc, open beneath, inclosing the genital organs.

This family nearly coincides with the genus *Cyanœa* Cuv. The four openings beneath the disc, conducting to the cavities which contain the organs for propagation, were by Péron and Lamarck incorrectly considered to be four mouths.

*Cyanœa* Cuv. (and species of the genus *Pelagia* ejusd.)

Genera: *Sthenonia* Eschsch., *Phacellophora* Br., *Cyanœa* Eschsch., *Aurelia* Péron; *Pelagia* Péron, *Chrysaora* Péron, *Ephyra* Eschsch. (*Euryale* and *Ephyra* Péron.)

Sp. *Cyanœa aurita, Medusa aurita* L.; Mueller *Zoolog. danic.* Tab. 76, 77; Ehrenb. *Abhandl. der Akad. zu Berlin, physik. Klasse* 1835; Cuv. *R. Anim. édit. ill., Zooph.* The four arms are considerably longer in old than in younger specimens; these arms consist of two laminæ crumpled at the edges, which during life face each other in such a way as to form a canal; after death they are flaccid and parted asunder. The disc is not quite circular, but in some degree divided by indentations of the margin into eight lobes. The four arms unite at the center of the body to form a circular aperture: this mouth leads to the stomach, which has four lateral cavities. From the stomach there run sixteen vessels to the margin of the disc, of which eight, divided into branches, alternate with eight others undivided and open at the margin. In addition, there are eight corpuscles at the margin, which Ehrenberg considers to be eyes, and which were noticed above. This species is found in the North Sea and the Baltic. Comp. H. M. Gaede *Beiträge zur Anatomie und Physiologie der Medusen, mit 2 Kupfertafeln*, Berlin, 1816, 8vo; Baer *Ueber Medusa aurita*, Meckel's *Archiv für die Physiol.* viii. 1823, s. 369—391, with fig.; F. Rosenthal *Beitrag zur Anatomie der Quallen, Zeitschrift für Physiol., herausgegeben von* F. Tiedemann, G. R. *und* L. C. Treviranus, i. 2, 1825, s. 318—330, with fig.

*Cyanœa capillata, Medusa capillata*, Baster *Natuurk. Uitsp.* ii., Tab. v. fig. 1.

*Pelagia noctiluca* Eschsch., *Medusa noctiluca* Forsk., Wagner *Bau der Pelag. noctiluca* and *Icon. Zool.* Tab. xxxiii.; in the Mediterranean, &c.

*Ephyra* Eschsch., probably rests on young forms of *Cyanœa;* comp. Will *Hor. Tergest.* Tab. ii. fig. 20, and Sars in Erichson's *Archiv*, 1841, Tab. ii.

Family IX. *Oceanidæ.* Disc without lateral cavities to inclose generative organs. Body campanulate. Mouth and œsophagus often elongated into a proboscis. Arms conspicuous or lobes around the mouth. Canals proceeding from the stomach elongate.

*Oceania* PÉRON (with the addition of several species, and other genera).

Subgenera: *Oceania* PÉRON, *Circe* MERTENS, *Conis* BRANDT, *Callirhoë* PÉRON, *Thaumantias* ESCHSCH., *Tima* ESCHSCH., *Melicertum* OKEN, *Cytæis* ESCHSCH., *Phorcynia* PÉRON.

Sp. *Oceania marsupialis* ESCHSCH., *Medusa marsupialis* L.; PLANC. *de Conch. min. not.* Tab. IV. fig. 5; MILNE EDWARDS, *Ann. des Sc. nat.* XXVIII. 1833, pp. 248—266, Pl. 11—13, Mediterranean; — *Callirhoë Basteriana* PÉRON, BASTER *Natuurk. Uitsp.* II. Tab. V. fig. 2, 3, &c.

Family X. *Æquoridæ*. Disc without lateral cavities, inclosing organs of generation. Body depresso-campanulate or plane. Mouth and œsophagus not elongated into a proboscis. Arms none or little evolved. Stomach with sacculated appendages or canals radiating, elongate, numerous.

*Æquorea* PÉRON, CUV.

Subgenera: *Æquorea* PÉRON, *Stomobrachium* BRANDT, *Mesonema* ESCHSCH., *Eurybia* ESCHSCH., *Polyxena* ESCHSCH.

Sp. *Æquorea Forskalina* ESCHSCH., *Medusa æquorea* FORSK. *Icon. rer. nat.* Tab. XXXII.; — *Æquorea violacea* MILNE EDWARDS *Ann. des Sc. nat.* 2e série, Tom. XVI. *Zool.* pp. 193—199; CUV. *R. Ani. éd. ill., Zooph.* Pl. 72; the margin has many conical cirri, the mouth is wide and round; from the stomach proceed about eighty long undivided rays (water-canals), which run towards the margin, and appear to open on a small conical point between two cirri. The genital organs are situated below on the disc, on each side of every ray as folded borders, but they do not extend as far as the margin. (ESCHSCHOLTZ divided the *Discophoræ* into *Cryptocarpæ* and *Phanerocarpæ, Syst. der Acal.* p. 41; to the last, which have the sexual organs placed crucially in the disc and attracting observation by their colour, belong the *Rhizostomidæ* and *Medusidæ;* to the first the *Geryonidæ, Oceanidæ* and *Æquoridæ;* in all of these the sexual organs have not yet been detected, but they will probably be found at the under side of the disc, and since in *Æquorea violacea*, according to the observations of MILNE EDWARDS, they strike the eye on this surface, and are also distinguished by their violet colour, we cannot accept the name *Cryptocarpæ*.

[The Cryptocarpæ of ESCHSCHOLTZ include the *naked-eyed Medusæ* of FORBES.]

Note to the *Discophoræ*. There remain certain genera of authors, in which a mouth has not been found, namely *Eudora* and *Berenice* PÉRON. (Sp. *Berenice rosea, Cuvieria* PÉRON *Voyage aux terr. austr.* Pl. 30, f. 2; GUÉRIN *Iconogr. Zooph.* Pl. 16, fig. 1.) These

genera, to which may be added *Stauraphora* BRANDT, form a family in the system of ESCHSCHOLTZ, to which he has given the name *Berenicidæ*. This family appears to me to be doubtful, as it does to BRANDT and others; we must leave the decision to time, I prefer to wait the result of new observations, rather than to attribute to Acalephs nutrition by superficial absorption.

For the rest, several genera of Acalephs are founded on figures of authors alone—and these sometimes imperfect and faulty. Hence no part of Zoology is more uncertain than this.

Accordingly there are many genera which I have not recorded, and possibly more might have been omitted. For here excess of timidity is better than dearth of prudence.

# CLASS IV.

## ECHINODERMS (*ECHINODERMATA*)[1].

THE name *Echinodermata* was used by J. T. KLEIN rather more than a century ago, to denote the shells of the sea-urchins, called *Echini*. Ἐχῖνος, with the Greeks, denoted both an urchin and a sea-urchin. Afterwards BRUGUIÈRES gave the name of *Echinodermata* to a division of the animal kingdom that comprised at once the sea-urchins and the star-fishes. CUVIER retained that name for this division, but added to it animals having a coriaceous skin without spines or quills. Although the name is no longer applicable to all the species of this class, yet the class itself must be looked upon as an extremely natural division of the Animal Kingdom. These animals are distinguished by an intestinal canal hanging free in the cavity of the body by single threads or membranes, usually long and tortuous, or provided with lateral appendages if it be short: blood vessels and respiratory organs are present; the genital organs, in both sexes of the same external form, are without any special apparatus for copulation; the fertilisation being

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[1] Consult on this class:

L. AGASSIZ, *Monographies d'Echinodermes vivans et fossiles.* Neuchcatel, 1838 and fols. 4to. (The parts thus far have reference only to certain figures of *Echini.* The fourth, published in 1842, contains the anatomical description of *Echinus lividus*, by VALENTIN.)

E. FORBES, *A History of British Star-fishes and other animals of the class Echinodermata. Illustrated by woodcuts.* London, 1841, 8vo.

A capital work on the anatomy of this class is:

F. TIEDEMANN, *Anatomie der Röhren-Holothurie, des pomeranz-farbigen Seesterns und Stein-Seeigels.* Landshut, 1816, folio; a prize Essay crowned by the French Institut in 1812.

W. SHARPEY, The article *Echinodermata* in TODD'S *Cyclopædia of Anat. and Physiolog.* II. pp. 30—46 (1836).

J. MUELLER, *Ueber den allgemeine Plan der Entwickelung der Echinodermen.* Mit 8 *Kupfertaf.* Berlin, 1853, 4to, and previous papers in the *Abh. d. Akad. der Wissenschaf. zu Berlin* 1849, 1850.

G. L. DUVERNOY, *Mém. sur l'Analogie de Composition et sur quelques points de l'Organisation des Echinoderms. Mém. de l'Acad. des Sciences*, XX. Paris, 1848.

effected by means of the sea-water in which these animals live. When parts are multiple, the number five prevails as remarkably in this class, as did the number four in the preceding: and the quintuple organisation is often obvious, as in star-fishes and sea-urchins, in the external form of the body. This is round or somewhat pentagonal in the sea-urchins; flat and spread out in rays in the star-fishes, with the mouth on the inferior surface. The *Holothuriæ* have, on the contrary, a cylindrical body.

In the star-fishes, of which the body is flat, the mouth conducts to a wide stomach that fills the disc of the body. It was supposed formerly that this stomach was in all of them a blind sac, as TIEDEMANN has described it in *Asterias aurantiaca* (*Astropecten aurantiacus* MUELL. and TR.) Afterwards MECKEL detected in *Comatulæ* a second opening of the intestinal canal, that lies on the same surface of the body with the mouth[1]. Only lately it has become apparent from MUELLER'S investigations, that in most of the proper *Asteriæ* an *anus* exists, and that the structure in *Ast. aurantiaca* is to be considered as the exception rather than the rule. But this second opening does not lie, as in the *Comatulæ*, on the same surface as the mouth, but opposite to it, on the back of the disc. In the *Ophiuræ* and *Euryale* it is wanting: consequently these, with some star-fishes (the genera *Astropecten*, *Ctenodiscus*, and *Luidia* of the moderns), and some Crinoïds are the only Echinoderms in which the intestinal canal forms a blind sac, as in the *Anthozoa*. In the *Asteriæ* proper, the intestinal canal has cæcal appendages, which divide into branches, and fill the rays of the body; in those species whose intestinal canal is a blind sac, the appendages proceed laterally from the stomach, at whose base on the dorsal surface there are usually two cæcal appendages in addition. In those Asteriæ which have an anal opening, the stomach is divided by a circular fold from a second compartment, to which the cæcal appendages of the rays are attached; to this succeeds a third compartment, the rectum, a short straight tube, which has also cæcal appendages; sometimes they are placed round the intestine in rays, like the appendages of the rays, and fill up

[1] *Archiv für die Physiologie* VIII. 1823. s. 470—477. The same observation was made by LEUCKART and HEUSINGER; see the not very clear description by the last-named in MECKEL'S *Archiv f. Anat. u. Physiol.* 1826. s. 317—324.

the spaces between the rays. In the disciform genus *Culcita*, the appendages of the rectum are greatly developed, five in number, each divided into two branches, and clustered[1]. In *Ophiura* and *Euryale* the cæcal stomach has lateral recesses, or even branched blind appendages, mostly ten in number, which, however, do not penetrate the rays. In *Comatula* the intestinal canal is tubular, and winds round a spongy structure in the axis of the disc; from this an edge projects, that penetrates into the canal and forms a valve[2]. In the sea-urchins (*Echinus*) the intestinal canal is very long. The œsophagus is tortuous, narrow, and beset with numerous follicles. Where it passes into the much wider intestinal canal, there is a cæcal appendage. The walls of the canal are very thin: its course is close to the shell in five arcs directed outwards; when it has returned nearly to the point from whence it began, it bends round and follows a similar route in an opposite direction, until at last, having become somewhat narrower, it mounts up to the anus (at the uppermost part of the shell). In the *Holothuriæ* the intestinal canal is nearly of the same width throughout. It proceeds from the mouth along one side of the body to the lower extremity, then bends back to the anterior part, and finally descends along the other side to the cloaca, into which the respiratory organs also open. In *Echiurus* the intestinal canal is, in like manner, much longer than the body, and makes many convolutions: it has numerous cystiform widenings, and very thin walls. In *Sipunculus*, where the anus is placed not at the end, but in the anterior half of the body, the intestinal canal, with its threefold bending, is nearly four times the length of the body. In *Synapta*, on the other hand, it is nearly straight, and about the length of the body, the anus being at the posterior extremity[3]. In the star-fishes probably the radiating appendages are to be considered as organs for preparing bile (liver): they are filled in *Ast. rubens* with a yellow turbid fluid[4].

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[1] J. Muellee und F. H. Troschell, *System der Asteriden*. Braunschweig, 1842, 4to, s. 132. Taf. xii, fig. 1.

[2] J. Mueller, *Abhandl. der Berl. Akad. a. d. J.* 1841, *Physik. Kl.* Tab. v. f. 7—10.

[3] Quatrefages, *Ann. des Sc. nat.* sec. série xvii., *Zoologie*, p. 51.

[4] Other writers consider the blind appendages at the bottom of the stomach or at the rectum as a rudiment of liver. Owen, *Lect. on the Comp. Anat. of invertebr. Animals*, 1843, p. 115. In these appendages a rudimentary form of kidney might also be recognised, an opinion, however, which does not rest on chemical investigation.

Notwithstanding much careful investigation, there still exists great obscurity about the circulation of the blood in *Echinoderms*. TIEDEMANN and DELLE CHIAJE give very conflicting descriptions of the vascular system—the difference being founded in the interpretation of the dermal vessels, which are connected with the organs of motion. The first of these authors considers the motion of fluid observed in these vessels to be altogether distinct from the circulation, whilst, according to the other, they are a part of the system of blood-vessels. In *Asterias* TIEDEMANN found on the inner surface of the skin of the back, a vascular ring, which he considers to be venous. The vessels which run upon the surface of the visceral appendages of the rays open into this ring. From it a canal arises, which performs the office of a heart, lying near the so-called lime-canal which is found there. The canal runs into a vascular circle surrounding the mouth, which TIEDEMANN holds to be arterial, and from which branches proceed to the intestines. Besides these two vascular rings (one on the dorsal and one on the abdominal surface), there is a third ring of an orange-yellow colour found on the inferior surface beneath the skin. TIEDEMANN was not able to discover any communication between this ring and the rest of the vascular system. In *Echinus* vascular rings occur, in like manner, round the mouth and the anus, on each surface two, of which one is to be considered arterial, the other venous. The heart is oblong, divided into many cells, and lying on the œsophagus[1]. In *Holothuria* there is a circulating system without a heart, or rather the heart has the form of a contractile vessel, that runs at the outside on the surface of the intestine. At the anterior extremity of the intestinal canal this vessel forms a vascular circle, whence very fine branches arise; when near the anus it has become small, having given off a multitude of fine branches, which run on the surface of the intestine. There is a transverse vessel which connects the longitudinal trunk on the first loop of intestine with that on the second. Many intestinal veins, which seem at the same time to perform the part of absorbents or

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[1] Comp. the descriptions and figures of VALENTIN, *Anatomie du genre Echinus*, pp. 89—96. Tab. VII. fig. 119, 125, 127. Tab. VIII. fig. 144—152, &c. There is a figure also of the heart and part of the blood-vessels in *Spatangus* in CUVIER'S *Règne Anim. éd. illustrée, Zoophytes*, Pl. 11 bis.

lymphatics, run upon the mesentery to form a stem, having a curved course, from which other vessels arise to run to the respiratory organ and so may be named pulmonary arteries. With these pulmonary arteries the pulmonary veins are in connexion, from whose union a longitudinal stem arises from which branches proceed to the arterial vessel with which we began our description [1].

Besides the blood-vessels already described there are other vessels which in *Echinoderms* provided with suckers or feet are in connexion with these organs of motion. The integument of the body is perforated by numerous pores arranged regularly in rows; in the sea-urchins the rows have been called, on account of their regularity, *Ambulacra*, from a comparison with orderly rows of trees and garden-walks. Through these pores membraneous cylindrical feelers (the feet) pass out, each terminating in a minute suctorial disc. According to the investigations of VALENTIN these feelers are in *Echini* perforated at their extremity by a fine aperture. Within the integument there are vesicles in connexion with them. The feelers, hollow within, are filled with a fluid, usually sea-water, which the animal can press at will from the vesicles, or, by contraction of the former, can cause to flow back. In this way the animals move their body, the numerous feet contracting and elongating, and adhering by means of the suckers. There are vessels corresponding to the rows of feet or feelers, from which lateral branches proceed to the vesicles of the feelers. The ordinary number of these longitudinal vessels of the integument is five; in the star-fishes their number corresponds with the number of the rays of the body. These lymphatics fall into an annular vessel surrounding the mouth. In *Holothuria* the appendages of the feelers which surround the mouth proceed from this annular vessel: and from it there arise also five other vessels that descend along the commencement of the intestinal tube, where they terminate in another annular vessel from which one or two oblong cæcal vesicles depend (*Ampulla Poliana*), that are in like manner filled with watery fluid [2].

The change of the blood from venous to arterial, the proper

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[1] See TIEDEMANN, *Anat. der Röhren-Holothurie*, s. 15—18, Tab. III.; comp. also CUVIER, *Règne Anim., édit. ill., Zoophytes*, Pl. 18.

[2] See the figures in TIEDEMANN, Tab. III. fig. 4, 6.

object of respiration, may be effected in any part of the animal organism, where the finest branches of the blood-vessels (the Capillaries) are bathed in the medium in which the animal lives. Hence it is easy to conceive that this function is not always necessarily connected with determinate parts.

In almost all *Echinoderms* the sea-water penetrates into the cavity of the body, and bathes as well the internal surface of the integument as the outer surface of the intestines. Where no especial respiratory organ exists, the function of such an organ, the change of the blood, may be effected in the fine vessels which run on the surface of the intestinal tube.

In the Star-fishes the sea-water penetrates to the cavity of the body by means of fine tubules in the integument, which are found in great numbers on the dorsal surface[1]. In *Ophiura* there are on the abdominal surface in each of the five fields between two rays, two or four fissures leading into the cavity of the body.

In the *Echini* it is not known with certainty in what way the water penetrates the cavity of the body. The ten branched organs round the mouth, which TIEDEMANN considers to be tubules to convey the water in and out, have, according to VALENTIN, no external apertures[2].

As little is known hitherto of the course which the water takes in most *Holothuriæ* to reach their cavity. In those which have no special respiratory organ, the genus *Synapta* has between the tentacles that surround the mouth four or five small papilliform eminences, having an opening at the apex and conducting to as many tubules that open between the muscles of the mouth. The openings are beset with cilia, like the tubules of the integument in Star-fishes[3]. In other *Holothuriæ*, as in those which TIEDEMANN investigated, there are special respiratory organs. From the Cloaca in which the intestinal canal terminates, there proceeds upwards a short tube, that soon divides into two very long principal branches which run as far as the anterior part of the intestinal canal. From these smaller tubes arise which subdivide into twigs which termi-

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[1] [This is TIEDEMANN'S opinion with respect to star-fishes, but the observations of SHARPEY, EHRENBERG and MUELLER, are opposed to it; they saw the streams of water from within turn back when they reached the extremity of the tubules.]

[2] VALENTIN, op. cit. p. 83.

[3] QUATREFAGES, op. cit. p. 65. Pl. 5, fig. 7, *f*.

nate in cæcal vesicles, or pulmonary cells. The right branch is intimately connected with the intestinal veins; the left branch of the respiratory organ is connected, by means of muscular fibres, with the internal surface of the integument. The form of this respiratory organ agrees with that of Lung, although *Holothuriæ* breathe water and not air. These parts are very contractile: in a *Holothuria* that was opened alive they did not cease, as long as life lasted, to force the water in and out by alternate contraction and expansion. But in respiration it is not the contraction of the muscular membrane alone of these branches that acts, but the contractility of the common integument of the body also. This contractility of the skin is so great, that occasionally, when the creature is irritated, a portion of the intestines together with the right branch of the respiratory organ is forcibly ejected from the Cloaca.

In the Sea-urchins VALENTIN considers the ten branched organs surrounding the mouth, first described by TIEDEMANN (and noticed above, vid. p. 132), to be external gills. As internal gills KROHN[1] and VALENTIN consider the foliated vesicles, which, in the interior of the shell, are in connexion with the ambulacral tubules: and which have a closely-woven vascular net-work. VALENTIN found, as has been stated, the ambulacral tubules perforated at the extremity in Sea-urchins. Through these openings the water penetrates into the vesicles, and the general opinion that the fluid is urged into the tubules from the vesicles and so distends them is not valid, according to VALENTIN, in the case of Sea-urchins[2]. In that of the Star-fishes and *Holothuriæ*, where the tubules appear to be imperforate, it has not been satisfactorily made out to what extent, if at all, the attached vesicles contribute to the respiratory act.

The organs for propagation are in different families of this class of a different form, but still, as was stated above, have, in the two sexes of the same species, exactly the same form. Hence, it appears that the discovery of the different sexes belongs exclusively to the latest scientific period, since formerly it was believed that all the individuals were of the same sex, either really bisexual or solely female[3].

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[1] MUELLER'S *Archiv.* 1841, s. 5, 6.

[2] [This observation of VALENTIN is contradicted by MUELLER, *Archiv.* 1850, p. 123.]

[3] WAGNER first discovered the difference of sex in *Holothuria tubulosa;* then PETERS, 1840, in *Echinus,* RATHKE in *Ophiura* and Sea-stars, &c.

Yet, without microscopic investigation, even the colour of the organs of propagation is sufficient to point out the difference of the sexes; the *testes* are distinguished by a milk-white, the *ovaria* by a yellowish-brown or red colour. In ninety-eight specimens of *Echinus* PETERS found that forty-three were males and fifty-five females, so that the two sexes are nearly equal in numbers. In *Comatula* also, MUELLER found the sexes distinct; the *ovaria* and *testes* are here situated on the *pinnulæ*[1]. In *Ophiura*, on the other hand, they lie in the disc, round the stomach as ten structures composed of lobes and blind pouches, that run into a pedicle; in the spaces between every two rays two such structures are placed close together so as to form five pairs[2]. In the Star-fishes they lie in the angles between the rays, and have the form of bunches of beaded strings: in some species they extend into the rays; their number is double that of the rays. On the dorsal surface, in some species, in each inter-radial space, two spots are found, which are perforated, sieve-like, by numerous closely arranged pores; these openings allow the ova or the seed to escape. In other species the products of the genital organs, which have been poured into the cavity of the body are probably allowed to pass out by the respiratory tubules on the back. In the Sea-urchins five ovaries or testes lie on the inner surface of the shell, and fill the spaces between the ambulacral plates. They are of an oblong flattened form, and consist of numerous cæcal pouches, which open into an excretory duct running through the midst of the organ. The duct then runs freely like a footstalk, by which the testis or the ovary is attached to the upper surface of the shell where it opens. There are thus five such openings, in five pentagonal calcareous plates around the anus. In *Holothuriæ* the ovary or testis is a bundle of branched tubes; these hang by their blind extremities downwards, and open above into a single excretory duct, being fastened to it like a brush. The oviduct or the efferent vessel lies along the anterior portion of the intestinal canal, and terminates near the anterior extremity of the body by a distinct opening on the dorsal surface. Near this canal

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[1] They are figured in the *Abh. der Berl. Akad. Bau des Pentacrinus*, Taf. v. fig. 17, 18.

[2] H. RATHKE *Beiträge zur vergl. Anat. u. Physiol., Reisenbemerkungen aus Skandinavien*, Danzig, 1842, 4to, s. 116, 117. Tab. II. fig. 3—7.

are situated pear-shaped vesicles, collected in some species into bunches, which TIEDEMANN conceives to be male genital organs, an opinion which falls to the ground now that the sexes are known to be distinct. Moreover they do not lead into this canal, but are in connexion with the œsophagus. It must be noted as a remarkable exception that in *Synapta*, according to the investigations of QUATREFAGES, a complete hermaphroditism prevails. The genital organs have the form of long strings, whose internal surface is beset with conical structures containing *Spermatozoa*, whilst the innermost cavity is filled with a pulpy substance in which the eggs are found. These eggs, as they grow, are pressed against the conical structures and so fertilized; and then the germ-spot, which was before visible, disappears. As the development of the eggs proceeds, the *testes* which adhered to the inner wall of the string and surrounded the eggs, are so much compressed that they become atrophied and disappear. This periodical development is a very remarkable physiological phænomenon [1].

With the exception of some interesting observations of SARS little was known respecting the development of Echinoderms until the last few years. [To the distinguished and unremitted labours of MUELLER we are principally indebted for nearly complete information respecting the very curious and unexpected processes which occur in different species. Very remarkable differences are observed according as more or less of the development is effected within the body of the parent, or according to the locality where the embryo is deposited on leaving the egg, or according to the different modes in which it is destined to acquire its food. As a general rule it may be stated that in littoral species when the embryo escapes at an early period from the egg the series of metamorphoses is less numerous: but that in pelagic species, where the embryo has to seek its food by swimming on the surface, the necessity for provisional organs of a complicated nature renders the changes very

[1] *Ann. des sc. nat.*, sec. sér. XVII. 1842. *Zool.* pp. 66, 73. A talented observer, whom we have already quoted when treating of Polyps, (p. 70.) STEENSTRUP has with much acuteness endeavoured to reject *Hermaphroditism* altogether, and is of opinion, that even here QUATREFAGES has taken cells of spermatozoa for eggs without the germinal spot. *Undersoegelser over Hermaphroditismus Tilvaerelse i Naturen*, Kjöbenhavn, 1845, 4to, pp. 63, 64. (SIEBOLD also surmises the same mistake of QUATREFAGES.) We shall perhaps recur subsequently to STEENSTRUP'S opinion.

remarkable. Amongst the *Ophiuræ*, *Ophiolepis squamata* is viviparous. The young, about ten in number, are developed between the integument and the wall of the stomach of the parent, in the inter-radial spaces, each in its own compartment, formed by membrane extended between the wall of the body and the stomach and suspended by a ligament attached near one of the angles of its disc. When fully formed it passes out by one of the genital fissures[1].] In *Echinaster sanguinolentus* the embryo according to the observations of SARS[2], on its escape from the egg is of an oval form and covered with cilia. Presently excrescences, club-shaped processes, arise at one extremity by which it adheres to the inferior surface of the disc of its parent, now converted by the infolding of the rays into a brooding cavity. When the arms begin to shoot forth these processes disappear, and feet or tentacles, few in number but proportionally very long, serve for the creeping and adhesion of the creature. The whole development occupies six or seven weeks. When the clavate processes are about to disappear they are near the edge of one of the inter-radial spaces of the disc of the Echinoderm. Of *Comatulæ* it had been discovered by THOMPSON[3] that during an early period of their life they are fixed to a stem and then resemble *Pentacrini*, in other words, that the form which in *Pentacrini* is permanent, is in them transitory. But their previous metamorphoses were unknown. [BUSCH has observed these changes from the egg until the period when the embryo is about to be attached. The egg having passed from the parent by an aperture at the side of the *pinnulæ*, remains attached to the *pinnula* by an abundant mucus, from spherical becoming oval, and the embryo may be seen rotating within the egg by means of its general covering of cilia. When the egg falls from the *pinnula* the embryo escapes: its oval form is elongated, the straight sides assume a gently undulating contour: on the tops of the undulations transverse bands of larger cilia are seen in place of the general ciliated covering: the bands are at first three in number, afterwards four, surrounding the body in parallel circles: the longitudinal axis of the body now becomes gently curved, and a mouth is seen on the concave surface: the bands of cilia disappear

[1] KROHN in MUELLER'S *Archiv.* 1851, s. 338—343.
[2] SARS in WIEGMANN'S *Archiv.* x. s. 169.
[3] THOMPSON, *Edinb. New Philos. Journal*, XX. p. 295.

and the creature having lost its apparatus for motion sinks to the bottom: tentacles in the meanwhile, five on each side of the mid-line, have been developed, and hooks are seen at the two extremities of the body which shew by their peculiar form that those extremities correspond to the ends of the arms: the embryo now cup-shaped from the increased convexity of its dorsal surface attaches itself to the bottom by this surface from which it secretes its pedicle. The absence of symmetry in the relation of the Echinoderm to its larva is indicated by the stem of the Echinoderm being placed at right angles to the axis of the larva, and the tentacles and mouth on the opposite surface[1].

In by far the greater number of Echinoderms the embryos pass gradually into forms which, however remarkably they may differ, are all laterally symmetrical. The axis becomes bent and on the ventral surface (that where the mouth opens) is a depression bounded above and below by transverse bands of cilia which are continuations of the lateral bands which bound the dorsal surface. They all have a complete digestive tube consisting of mouth, œsophagus, stomach, intestine and anus. This tube is placed in the median plane, the mouth in the ventral depression described above, and the tube curves from it to terminate beyond the transverse band of cilia above the mouth on the same ventral surface. Also they have all an aquiferous system, a tube terminating externally in a dorsal pore and internally in a sac. When MUELLER observed the singular forms of the larvæ of *Ophiuræ* and *Echini* with their long processes supported by slender rods of carbonate of lime he named them *Pluteus* from their general resemblance to a painter's easel with his work upon it. In *Asteriæ* and *Holothuriæ* the larvæ have a more flattened form, like a coat of arms with its surrounding ornaments. The process of development in these different larval forms is two-fold. In the first case the body of the Echinoderm is formed by gemmation round the stomach of the larva, which continues to be *its* stomach, and when it is formed, all that remains of the larva, with the exception of certain structures in connexion with the aquiferous system is gradually (*Ophiura* and *Echinus*) or simultaneously (*Bipinnaria asterigera*) rejected. In the second case the symmetrical

[1] [Comp. *Beobach. uber Anatomie u. Entwickelung einiger wirbellosen Seethiere von* DR. W. BUSCH. fol. Berlin, 1851, s. 82—88.]

larva with its bilateral ciliated band passes into the radial type, as in the larva of *Comatula:* it has a cylindrical form with five transverse bands of cilia. From this pupa-state the Echinoderm is developed without the rejection of any part of the pupa. It is either formed upon a part of the pupa, and the rest is absorbed by it (*Tonnaria* of certain *Asteriæ*), or the entire pupa is simultaneously metamorphosed into the Echinoderm (*Holothuriæ*). In both these cases, but especially the first, the axis of the Echinoderm does not coincide with the axis of the larva, but crosses it at a large angle. Cæcal processes are formed round the stomach of the larva in connexion with the vesicle of its aquiferous system: they are the rudiments of the water-canal around the mouth of the Echinoderm and of the vessels which proceed to the tentacles and feet. Where the afferent water-tube meets the surface of the Echinoderm the madrepore-plate is formed, and the portion of the tube within the body of the Echinoderm becomes its stone- or lime-canal. In *Ophiuræ* the madrepore-plate has been discovered by MUELLER[1], its pores do not open externally being covered by a plate of the inferior surface of the disc. In *Holothuriæ* it is within the abdominal cavity, in *Asteriæ* on the dorsal surface, in *Echini* it coincides with one of the genital plates. In all these cases a tube, whether it be hardened by carbonate of lime (stone-canal) or not, runs from the madrepore-sac or plate to the circular aquiferous canal surrounding the œsophagus.]

The power of reproduction in Echinoderms is very great. Starfishes are frequently seen with one or more small arms or rays, that have been formed anew in consequence of the loss of the parts. GUETTARD and BERNARD DE JUSSIEU confirmed the reproduction by many experiments[3]. In *Holothuriæ* even viscera may be lost and formed anew; and some species are propagated by spontaneous division[4].

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[1] MUELLER *Archiv.* 1850, p. 121.

[2] Comp. MUELLER *Die larven u. metamorphos. der Ophiuren u. Seeigel.* Berlin, 1848, 1849 and 1852. MUELLER *Uber die larven u. metamorph. der Holothurien u. Asterien,* Berlin, 1850. MUELLER *Ueber den allgemeinen Plan in der Entwickelung der Echinodermen.* Berlin, 1853.

[3] RÉAUMUR *Mem. pour servir à l'Hist. des Ins.* VI. Préface, pp. 61, 62.

[4] According to the observations of SIR J. GRAHAM DALZELL, quoted by FORBES, *Hist. of British Star-fishes,* pp. 199, 200.

The nervous system of Echinoderms was first described and figured by TIEDEMANN in *Asterias aurantiaca* (*Astropecten*)[1]. There is found around the mouth a nervous ring without ganglia, whence is given off a fine thread for each ray, and running along it. On each side of this thread is another, which descends into the cavity of the body. In sea-urchins also and in star-fishes, in which TIEDEMANN could only detect obscure traces of a nervous system, KROHN discovered a few years ago a distribution similar to that of *Asteriæ*. In *Echinus* the ring surrounds the mouth within the apparatus usually named Aristotle's Lantern (see below in the systematic arrangement): in *Holothuria* in the calcareous ring to which the longitudinal muscles are attached. Five principal nervous stems run with the vessels that are in connexion with the ambulacral apparatus[2].

Little is known of special organs of sense in Echinoderms. In star-fishes EHRENBERG discovered at the point of the rays on the abdominal surface, a small red spot, surrounded by a ring of calcareous tubercles, which he considers to be an eye. In specimens preserved in spirit the pigment disappears, and so the existence of the spots cannot be recognized. Moreover they are wanting in many species[3]. FORBES discovered five similar spots in sea-urchins, on the upper surface, situated upon as many pentagonal plates that alternate with five larger plates on which the oviducts open. Both in the star-fish and sea-urchin each of the five principal nerves runs as far as one of these spots and ends beneath it[4]. But in neither of these animals has a lenticular transparent body been discovered. The ambulacral tubes and the feelers around the mouth may, as highly sensitive parts, be ranked amongst the organs of touch.

To the motive apparatus of Echinoderms belong the little feet or tentacles, already noticed, the ambulacral tubules by means of which the animals creep. They have muscular fibres on their walls. In *Echinus* VALENTIN found in them both transverse and longitudinal bundles, and radiating fibres in the suckers at their termination. He conceives that the motions of the ambulacral tubes are

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[1] In MECKEL'S *Archiv f. die Physiol.* I. 1815, s. 161, &c. and in his often quoted prize essay.

[2] MUELLER'S *Archiv.* 1841, pp. 1—13, Tab. I.

[3] *Die Akalephen des rothen Meeres*, s. 32—34, Tab. VIII. fig. 11, 12.

[4] Comp. VALENTIN, op. cit. pp. 11, 100, Tab. II. fig. 12, Tab. IX. *f.* 188—190.

effected by means of these muscular fibres, and in no degree by forcing fluid into and out of them. To how great an extent these parts can be elongated may be judged by the length of the spines of the shell in sea-urchins: they must have the power of extending beyond the longest spines. In specimens that have been kept in spirits these tubules are found to be short and mutually entangled. The teeth, and the curious apparatus that encloses them (ARISTOTLE'S *Lantern*) have a number of proper muscles. As to the general muscular system, that which moves the whole body, it is found especially developed in *Holothuriæ*. Here ten muscles run the whole length of the body, beneath the skin: they are arranged in pairs, which are separated by spaces in which transverse circular fibres are found that cover the entire inner surface of the skin. By means of the longitudinal muscles the body can be shortened and bent: by the transverse fibres it is contracted transversely, and so attenuated and elongated. The longitudinal muscles are inserted into a calcareous ring composed of five large and five smaller pieces, and surrounding the commencement of the intestinal canal.

All these animals inhabit the sea. They are found in all parts of the world: yet, most of the species only in limited regions. Since we have only a partial acquaintance with foreign species, many more of which will doubtless be hereafter discovered, we are not in a condition to give a survey of the geographical distribution of the genera. Unlimited confidence is not to be reposed in the accounts given by some writers of the localities in which the species are native. Of the *Asteriæ* nearly one-third of the known species are found in the East-Indian seas, one-fifth in the seas of Europe. Of *Ophiuræ*, on the other hand, the European and African species are more numerous than the East-Indian. The western hemisphere has, on the whole, fewer star-fishes than the eastern: in America there are no species of *Scytaster*, as, for instance, of *Culcita*, *Astrogonium*, *Stellaster*; *Echinaster*, on the other hand, is peculiarly American. The species of *Euryale* are chiefly found in the Arctic and in the Indian seas. To the species which are very generally distributed belongs that which occurs on the coast of Holland, *Asterias* (*Asteracanthion*) *rubens*. The Red sea so rich in species of the class of Polyps, has only a comparatively small number of star-fishes, and, in this respect is much behind the Mediterranean, which is especially rich in species of *Astropecten*. The Baltic appears to be

avoided by Star-fishes[1]. Of Sea-urchins about one-third of the known species are found in the East-Indian seas: here especially are found *Cidarites* and *Scutella*. Of *Holothuriæ* more species appear to be met with in the southern Pacific than in other seas. The western hemisphere is as much behind the eastern in respect of *Echini* and *Holothuriæ* as of Star-fishes.

[1] Comp. MUELLER u. TROSCHELL *Ueber die geographische Verbreitung der Asteriden* in WIEGMANN'S u. ERICHSON'S *Arch. f. Naturgesch.* x. 1843, s. 123—130. We have borrowed the above short notices on the geographical distribution of the *Echinodermata* from the *System der Asteriden* of these writers, and from LAMARCK *Hist. nat. des Anim. sans vertèbres*, (compared with the specimens in the Leyden Museum).

# SYSTEMATIC

# ARRANGEMENT OF ECHINODERMS.

## CLASS IV.

### ECHINODERMATA.

ANIMALS with integument coriaceous, often calcareous; with distinct nutrient canal, freely suspended in an abdominal cavity. Organs of circulation and generation conspicuous; sexes nearly always distinct. Disposition of the organs most frequently quinary, with body mostly radiate or globose, in some cylindrical. Distinct vestiges of a nervous system, a ring for the most part surrounding the mouth and sending off nerves radially.

#### ORDER I. *Pediculate Echinoderms.*

Tentacles numerous, membraneous, contractile, terminated by a suctorial disc, and issuing from minute apertures in the integument.

Family I. *Crinoïdea.* Integument calcareous (external skeleton). Rays articulate, supplied with a central canal, absent in some. Mostly two apertures of the nutrient canal.

The name *Crinoïdea*, given by MILLER to this division of the animal kingdom, is derived from κρίνον, a lily. At the beginning of the last century the name *sea-lily*, *stone-lily* was given to the *Encrinus moniliformis*, or *liliiformis*, a remarkable petrifaction of the *Muschelkalk*. Most of them are set upon a stem; the non-pediculate (*Comatula* LAM.) in the young state, according to the observations of THOMPSON, are also fixed to a pedicle. The non-pediculate species known to LINNÆUS were placed by him in the genus *Asterias* (*Asterias pectinata*, *Ast. multiradiata*); the pediculate species in the

genus *Isis*, confounding the fossil *Encrinus* and the *Pentacrinus caput Medusæ* of the existing creation under the name of *Isis Asteria*. This singular union of an Echinoderm with a genus of Polyps had doubtless an influence upon the later arrangement of LAMARCK, who placed *Encrinus* (see above, p. 80) amongst the sea-feathers. SCHWEIGGER and CUVIER restored it to the proper place, already assigned to it in the middle of the previous century by GUETTARD, who first described *Pentacrinus caput Medusæ*. This whole family belongs rather to the former period of the history of our globe, than to the present. The species now living in our seas are almost all non-pediculate, whilst geological investigation has made us acquainted with numerous forms of pediculate sea-lilies. What is now a youthful mutable form of life was then the prevalent and permanent. The same thing may be observed in other classes also with respect to the fossil representatives of *genera* that are living at the present time.

The chief work on this family is:

J. S. MILLER, *Natural History of the Crinoïdea*, Bristol, 1821, 4to.[1]

## A. *Crinoïds affixed.*

*a*) *Sessile.*

*Holopus* D'ORBIGNY. Calyx affixed, hollow, undivided, with scattered tubercles. Four calcareous pentagonal parts at the upper margin of the calyx, sustaining four pairs of articulate and pinnate arms.

Sp. *Holopus Rangii*, D'ORBIGNY, GUÉRIN *Magasin de Zool.* 1837, Cl. x. Pl. 3; from the Caribbean Sea at Martinique. Both in the want of a stem and the number of the arms this genus differs from the other Crinoïds.

*b*) *Pediculata.* An articulate column sustaining the calyx.

* *Tesselata.* Calyx non-articulate.

*a*) Rays or arms none.

Genera: *Sphæronites* HISINGER, *Pentatrematites* SAY (*Pentremites* GOLDF.), *Echinosphærites* WAHL., *Hemicosmites* GRAY, *Sycocystites* v. BUCH.

Fossil genera from the Transition- and Mountain-limestone. Comp. BRONN, *Lethæa geognostica* 1835, Tab. IV. fig. 1, &c. According to the opinion of some these were pediculate *Echini*.

*β*) With rays.

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[1] See also W. BUCKLAND, *Geology and Mineralogy*, London, 1835, pp. 416—442.

Genera: *Caryocrinites* SAY, *Platycrinites* MILL., *Actinocrinites* MILL., *Rhodocrinites* MILL., *Cyathocrinites* MILL., *Poteriocrinites* MILL., *Melocrinites* GOLDF.

For these fossil genera and others unnoticed we must for want of space refer to MILLER's work already cited, to GOLDFUSS *die Petrefacten Deutchlands*, and other geological works. Comp. also GOLDFUSS *Ueber fossile Crinoideen*, *Nov. Act. Acad. Cæs. Nat. Curios.* XIX. I. 1839, p. 329—352, and L. v. BUCH on *Caryocrinus ornatus* in his work *Ueber Cystideen*, Berlin, 1845, 4to.

In these and the following pedunculate Crinoïds, the cup-like part at the extremity of the stem and base of the arms is named *Calyx*. The bottom of this part, which is pentangular, and composed of five, four, or sometimes three plates, is named by MILLER *pelvis*; JOH. MUELLER names the plates *basalia*; at the margin of these plates are the basal-pieces of the arms, forming the uppermost part of the *calyx*; there are two or three rows, and the uppermost bears the arms. MILLER gives to this part the name of *scapula*; the two pieces situated below are *costæ*. JOH. MUELLER names these pieces *radialia* (*radiale primum*, *r. secundum* and *r. axillare*; his *radiale axillare* is the *scapula* of the English author). In those now named *Crinoïdea tesselata* these parts are joined together without articulation. The fossil species of this division are found in the transition-limestone and the grey-wacke.

** *Articulata.* The rays free directly from the pelvis of the calyx, the first radial conjoined to the second, and the second to the third by articulation.

*Apiocrinites* MILL. Column incrassated towards the calyx, pyriform.

Sp. *Apiocrinites rotundus* MILL. Tab. I—VII. *Apiocrin. Parkinsonii* BRONN, *Lethæa* Tab. XVII. fig. 15, (MILLER'S figure) fossil from the oolite formation, like other species of this genus.

*Encrinus* GUETTARD (in part). Column round, not incrassated towards the top.

Sp. *Encrinus liliiformis* LAM., *Encrinites moniliformis* MILLER, pp. 37—44, Tab. I—III.; ELLIS *Corall.* Tab. 37, fig. K, &c. One of the most characteristic fossils of the *Muschelkalk*. The head, on account of the numerous articulations of the arms that lie side by side, resembles an ear of Turkish wheat (*Zea Mays*); the joints of the stem, sometimes found in incredible numbers, changed into calcareous spar, are named *Trochites*[1].

[1] QUENSTEDT (*Ueber die Enkriniten des Muschelkalks*, WIEGMANN'S *Archiv.* 1835, II. s. 223—228, Taf. IV.) describes a species with different division of the arms, under the

*Pentacrinus* MILLER. Column not incrassated towards the top, pentagonal with joints having a pentapetalous mark. Cirri adhering to the column in whorls.

The fossil species of this genus belong to the oolite period, as, *ex. gr. Pentacrinus briareus* MILLER, pp. 56—58, Tab. I. II. CUV. *R. Ani. éd. illustr., Zooph.* Pl. 7, fig. 1, from the Lias-schist.

The living species of this genus, *Pentacrinus Caput Medusæ*, is found in the Caribbean Sea, and was first described by GUETTARD *Mém. de l'Acad. Roy. des Sc.* 1755 (Paris, 1761) pp. 224, &c. Pl. 8—10; another, more mutilated specimen, found on the coast of Barbadoes, was described by ELLIS in 1761, *Phil. Transact.* vol. 52, p. 357, Pl. XIII. Specimens of this species are rare in Museums, seven only, as far as is known, existing in the different Cabinets. The most complete description was given not long ago by J. MUELLER (*Ueber den Bau des Pentacrinus Caput Medusæ*, Berlin, 1843, folio). The stem of *Pentacrinus* has no muscles, but is merely passively motile, or flexible by means of fibrous bundles and an elastic tissue between the joints. The arms and *pinnulæ* are moveable by muscles without transverse stripes; these muscles are situated on the side corresponding to the mouth, and can only flex the parts: extension, or motion outwards, seems to be effected merely by the elasticity of the parts. The growth of the joints of the stem occurs in the part at the top nearest to the calyx, which corresponds to what is observed in the growth of the joints in worms and *entozoa*.

## B. *Free Crinoïds.*

### *a) Tesselate.*

*Marsupites* MANTELL. *Marsupiocrinites* BLAINV. Calyx of parts calcareous pentagonal striated; arms?

Sp. *Marsup. ornatus* MILL. *Crinoïd* p. 134, with figure, BRONN, *Leth.* Tab. XXIX. f. 13; (Tab. XXXIV. fig. 9, with conjectural restoration of the arms after the figure of MANTELL); fossil from the chalk-period.

### *b) Articulate.*

*Comatula* LAM. (*Alecto* LEACH; MUELL. Cirri dorsal articulate, around a pentagonal disc. Radials mostly without basals

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name of *Encrinites Schottheimii* of which H. V. MEYER has formed a new genus, *Chelocrinus*. See the paper of the latter; *Isocrinus und Chelocrinus, Zwei neue Typen u. s. w., Museum Senkenbergian.*, II. p. 249.

composing the calyx. Rays pinnate; pinnæ sulcate, the furrows confluent with the longitudinal furrow of the rays; tentacula situated in the furrows. Mouth and anus on the ventral side; mouth central in the bottom of the calyx; anus lateral, tubular.

See J. MUELLER, *Ueber die Gattungen und Arten der Comatulen*, 'ERICHSON' *Archiv für Naturgesch.* 1841, s. 139—148, and *Neue Beiträge zur Kenntniss der Arten der Comatulen, ibid.* 1843, s. 131—136.

* *Rays of Calyx bifid (ten-rayed).*

Sp. *Comatula rosacea, Alecto europæa* LEACH, FORBES *Brit. Starf.* p. 5. To this species belong the observations of THOMPSON spoken of above, (pp. 136 and 143). Memoir on the *Pentacrinus europæus*, Cork, 1827. *Comat. carinata* LAM., GUÉR. *Iconogr. Zooph.* Pl. 1. fig. 2.

** *Rays of Calyx multifid (many-rayed).*

Sp. *Comatula multifida* MUELL., *Com. multiradiata* LAM. &c.
The species, which like Pentacrinus have a *pelvis*, form the genus *Comaster* AGASS., MUELL. Here belongs *Comatula multiradiata* GOLD. (not LAM.) Fossil species of this genus are found in lithographic stone.

Family II. *Asteridea.* Body depressed, free (not pediculate), multangular or radiate, with integument coriaceous or calcareous. Row of joints calcareous internal, running along the middle of the rays and taking their origin from the mouth. Mouth central, inferior; anus dorsal or none.

A capital work on this division was published some years back, *System der Asteriden* von J. MUELLER und F. H. TROSCHELL, mit 12 Kupfertafeln, Braunschweig, 1842, 4to. As plates for this and the preceding family may be recommended: J. H. LINCKII *De Stellis marinis Liber singularis*, Lipsiæ, 1733, fol.

Phalanx I. *Ophiuræ.* Disc distinct from the arms; with arms non-sulcate. Anus none.

*Euryale* LAM. (*Gorgonocephalus* LEACH). Arms prehensile, contortile towards the mouth, not scutate, sub-rotund, flattish beneath. Disc tumid, sub-globose, with five obtuse angles.

According to the division of the arms the species of this tribe are arranged in three different genera by MUELLER and TROSCHELL. They are undivided in *Asteronyx*, divided dichotomously and only towards the end in *Trichaster* AGASS., divided from the base, first

dichotomously and afterwards into many branches, in *Astrophyton* LINCK. To the last division belongs:

Sp. *Euryale verrucosum* LAM., *Asterias Caput Medusæ* L. (in part) RUMPHIUS, *Amb. Rariteitkamer* Tab. XVI. CUV. *R. Ani., édit. illus., Zooph.* Pl. 5, from the Indian Sea; a very similar species is found in the North Seas, and distinguished by MUELLER and TROSCHELL as *Astrophyton Linckii;* LINCK *de Stell. mar.* Tab. 29, fig. 48. These *Medusa-heads* belong to the most singular and beautiful forms of radiate animals. Vid. FORBES *Br. Starfishes,* pp. 67—70.

*Ophiura* LAM. Arms five, undivided, serving for creeping, scutate, articulate. Disc plane, with two or four genital fissures in each interbrachial area on the ventral side.

The name *Ophiura,* from ὄφις, *serpent,* and οὐρά, *tail,* denotes very appropriately the form of the arms by which these *Sea-stars* are distinguished, and which are often so long as to exceed five or six times (nay in *Ophiura longipeda* even twenty times) the diameter of the disc.

Sub-genera: *Ophiocoma* AGASS., *Ophiolepis, Ophiarachna, Ophiacantha, Ophiomastix, Ophiomyxa, Ophioscolex, Ophiothrix, Ophiocnemis, Ophioderma,* MUELL. and TROSCH.

Sp. *Ophiura texturata* LAM., *Asterias ophiura* L. (in part), *Ophiolepis ciliata* MUELL. and TROSCH., LINCK *de Stell. mar.* Tab. II. fig. 4, *Encyclop.* Pl. 123, fig. 2, 3. FORBES *British Starf.* p. 22, &c. in the Mediterranean, the North Sea, &c.

Phalanx II. *Asteriæ.* Body depressed, angulate or stellate the angles being produced, with tentaculiferous furrows below, extending as far as the point of the angles. Anus dorsal in most, surrounded by a mound of calcareous papillæ.

*Asteria* LAM. (Most are species from the genus *Asterias* L.)

The *Sea-stars.* The form is very various, so that in some species the entire body seems to consist only of arms, *ex. gr.* in *Ophidiaster,* in others only of a pentagonal disc. But the arms are never sharply separate from the disc as in the *Ophiuræ,* but are an immediate continuation of it. In most of the species there are five rays, however in these sometimes four or six occur as exceptions; six arms as the normal number are found in *Asterias gelatinosa,* in *Echinaster eridanella,* six or seven in *Asteriscus Diesingii,* seven to nine in the sub-genus *Luidia,* eight to ten, mostly nine, in *Solaster endeca,* eleven to fourteen, generally twelve, in *Solaster papposus,* twelve or thirteen in *Asterias aster,* fifteen in *Asteriscus rosaceus,*

fourteen to one-and-twenty in *Echinaster solaris;* finally, in *Asterias helianthus* the rays are found up to thirty and more. The greater the number that any species possesses, the less is it constant. On the dorsal surface is placed a calcareous star-formed plate between two rays of the disc (*verruca dorsi, tubercule madréporiforme, Madrepore-plate*), which in *Ophiura* is wanting, and in *Euryale* lies on the oral surface. AGASSIZ who endeavours, with great acuteness, to prove a lateral symmetry in the *Echinodermata*, considers the ray that is opposite to this plate to be the first ray of the body. A tortuous tube proceeds from this dorsal plate downwards as far as the mouth, and is filled internally with a calcareous matter (see above, p. 130).

This tube was named by TIEDEMANN (*Anat. der Roehren-Holoth.*, &c. 53, 54) *Stone-canal* or *Sand-canal;* it terminates, becoming narrower, in the circular vessel surrounding the mouth and filled with watery fluid; see above, p. 131. SIEBOLD has closely investigated the calcareous balk, consisting of several joints and internally hollow, which occupies this canal and described its complicated structure; MUELLER'S *Archiv.* 1836, s. 291, &c. [Also SHARPEY, in TODD'S *Cyclop. of Anat. and Phys.* II. pp. 35, &c., describes in the interior of the jointed calcareous tube a lamina attached longitudinally, which passes inwardly a certain way and then separates into two which are rolled in opposite directions, something after the manner of the inferior turbinated bone of the ox.]

The Sea-stars can bend their rays towards each other, which is serviceable in moving through narrow fissures and between stones. They do not swim, but creep by means of their tentacles with mouth downwards. They feed principally upon Molluscs.* Though the genus *Asterias* of LAMARCK, by the exclusion of *Comatula, Ophiura* and *Euryale*, be much more narrowly limited than the same genus in the *Systema Naturæ* of LINNÆUS, still the species are too numerous and the forms too various not to be regarded rather as a natural group which ought to be divided into several *genera* or *sub-genera.* This has been done by LINCK, and more lately especially by AGASSIZ and MUELLER and TROSCHELL, to whose works we refer. The primary division of the group by MUELLER and TROSCHELL is founded on the Tentacles, which in most of them are placed in two rows in every furrow, but in others in four rows.

A. *Ventral furrows, with two rows of tentacles.*

* *Anus none.*

*Astropecten* LINCK. (*Astropecten* and *Ctenodiscus* MUELL. and TROSCH.), *Luidia* FORBES.

Sp. *Astropecten aurantiacus, Asterias aranciaca* L., LINCK, *de Stell. mar.* Tab. 5, fig. 6, Tab. 6, fig. 6, TIEDEMANN *Anat.* Tab. 5, 6, FORBES *Br. Starf.* p. 130; in the Mediterranean and Atlantic Ocean.

** *Anus central, or sub-central, dorsal.*

*a) Body disciform, with short rays.*

*Asteropsis* MUELL. and TROSCH., *Stellaster* GRAY, *Goniodiscus* MUELL. and TROSCH., *Astrogonium* MUELL. and TROSCH., *Asteriscus* MUELL. and TROSCH., *Pteraster* MUELL. and TROSCH., *Culcita* AGASSIZ.

Sp. *Culcita discoïdea, Asterias discoïdea* LAM., SCHMIDEL in *Naturforsch.* XVI. 1781, Tab. I., BLAINV. *Actinol.* Tab. 23, f. 1; *Asteriscus palmipes, Asterias membranacea* RETZ, GMEL., LINCK, *de Stell. mar.* Tab. 1, fig. 2, BLAINV., *Actinol.* Tab. 23, fig. 2, FORBES *Brit. Starf.* pp. 116, &c.

*b) Body stellate, with rays distinct, surpassing the disc three times or more.*

*Archaster* MUELL. and TROSCH., *Oreaster* MUELL. and TROSCH., *Scytaster* MUELL. and TROSCH., *Ophidiaster* AGASS., *Chætaster* MUELL. and TROSCH., *Solaster* FORBES, *Echinaster* MUELL. and TROSCH., (and *Echinites* in ERICHS. *Archiv.* 1844).

Sp. *Solaster papposus, Asterias papposa* L., LINCK *de Stell. mar.* Tab. 32, Tab. 34, fig. 54, FORB. *Brit. Starf.* p. 112, in the Atlantic, on the coast of England and Scotland, &c.; when fresh of a beautiful red colour above, of a yellowish brown below; *Echinaster solaris, Echinites solaris, Asterias Echinites* LAM., *Naturforsch.* XXVII. 1793, Tab. I, II. from the East Indian Seas, &c.

B. *Ventral furrows with four rows of tentacles. Body with distinct rays, with integument coriaceous, aculeate. Anus dorsal, sub-central.*

*Asterias* GRAY, (species of the genus *Asterias* L., *Asteracanthion* MUELL. and TROSCH.)

Sp. *Asterias rubens* L., LINCK *de Stell. mar.* Tab. 36, fig. 6*r*, BASTER *Natuurk. Uitsp.* I. Tab. XII. fig. 1—4, FORBES *Brit. Starf.* p. 83: the common Sea-star, Cross-fish; so common on some coasts as to be used for manuring the land in the neighbourhood. *Asterias helianthus* LAM., *Encyclop.* Pl. 108, 109, BLAINV. *Actinol.* Tab. 23, fig. 5, in the Pacific and at Chili; one of the most remarkable and most beautiful species, &c.[1]

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[1] For a knowledge of the numerous species of *Asteridea* comp. also J. E. GRAY, *Synopsis of the Genera and Species of the class Hypostoma (Asterias* L.) *in the Annals*

Family III. *Echinidea.* Body sub-globose or depressed without radiant lobes. Mouth and anus distinct. Mouth inferior. Integument calcareous, beset with moveable spines.

*Sea-Urchins.* Compare on this family (besides the *Monographies d'Echinodermes* of AGASSIZ cited above) JAC. THEOD. KLEIN *Naturalis dispositio Echinodermatum cum tab. Gedani* 1734, 4to. *Ordre naturel des Oursins de Mer et fossiles* par M. THEODORE KLEIN, Paris 1754, 8vo. av. fig. (Many of KLEIN's figures are copied in the *Encyclopédie methodique, Vers.*) M. VAN PHELSUM, *Brief aan* C. NOZEMAN *over de gewelv-slekken ov Zee-egelen.* Met 3 pl., Rotterdam, 1774, 8vo. CH. DESMOULINS, *Études sur les Echinides*, Bordeaux, 1835—1837, 8vo.

The shell of these animals consists of an arrangement of plates having a pent- or hexangular form. They compose ten girdles, each made up of two rows of such plates. Five of the girdles, commonly narrower than the others, have two rows of small apertures and alternate with these. The rows of apertures are named *ambulacra*: they either entirely surround the periphery (*ambulacra perfecta*), or are found only on the uppermost part, resembling in their arrangement a star or five-petalled flower (*ambulacra circumscripta*). By these apertures the tentacles or *ambulacral tubes* are exserted, of which we have treated above. The Sea-Urchins effect their movements by means of these tubes[1], they appear to have a great power of elongation, to be able to stretch farther than the extremities of the rigid spines, which in certain species are some inches in length. Around the anus are five larger apertures (in some genera only four) which are the outlets of the oviducts or efferent vessels; they are situated in as many pentagonal calcareous plates, with the point directed outwards, of which one, larger than the rest and of a different structure, corresponds to the calcareous plate (*madrepore-plate*) of the Sea-stars, as BASTER had previously

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*of Natural History* VI. 1841, pp. 175—184, pp. 275—290. Want of space prevents our noticing the numerous generic names of GRAY; some *genera* agree with those of MUELLER and TROSCHELL, of which a more detailed notice by AGASSIZ may be found in the preface to the second number of his *Monographies d'Echinodermes*, pp. 5, 6.

[1] GANDOLPHE *Quelles sont les jambes des Oursins? Mém. de l'Acad. des Sc. de Paris pour* 1709, *Histoire*, p. 33. With his observations those of BASTER, TIEDEMANN and others completely agree; AGASSIZ, who at one time considered the spines to be organs of motion, and doubted that such was the office of the ambulacral tubes, has since renounced that opinion.

observed[1]. Between these five genital plates, lie five smaller (the *ocellar plates*), also pentagonal but with the point turned inwards, so that the plates are wedged into the spaces between the points of the first five. There are still other smaller plates, variable in number, that lie within the ring formed by these ten, and immediately surround the anus.

The chemical composition of the calcareous shell is remarkable on account of the extremely small proportion of organic matter; it consists almost entirely of carbonate of lime. The growth of the shell is effected by enlargement of the plates, and by addition to their number upwards; hence younger individuals are flatter than older ones, and the form of itself alone becomes a deceptive criterion in determining species.

The moveable spines, of which the number increases with the age, have at their base a small cavity, by which, as by an articular surface, they are connected with the tubercle of the shell. These tubercles are placed in rows, like the apertures of the *ambulacra*, and are found both on the ambulacral and on the interambulacral fields.

The mouth is provided with five teeth, whose points are sharp and hard, and meet in a pentagon at the inferior aperture. These teeth are long rods, which become soft and transparent inwards. They perforate five triangular pyramids, which by their mutual arrangement form a conical apparatus with the broad base facing inwards, and to which base still other small calcareous pieces are united. This very complicated apparatus, with its provision of muscles, bears the singular name of ARISTOTLE'S *lantern*[2].

Sea-urchins cannot swim, but only creep along the bottom of the sea. There are species that sometimes live in cavities which they have formed in the rocks[3].

The food of the Sea-urchin consists, according to the microscopic investigation of the excretions in *Echinus lividus* by VALENTIN,

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[1] *Natuurk. Uitsp.* I. bl. 132.

[2] This apparatus is described in detail by CUVIER *Leçons d'Anat. comparée*, Paris 1805, III. pp. 329—335, and 2e édit. Paris 1837, VI. pp. 377—382; comp. also the works of TIEDEMANN and VALENTIN already cited, and R. JONES, *Outline of the Anim. Kingd.* pp. 166—169.

[3] *Echinus lithophagus* of LEACH, which does not appear to differ from *Echinus lividus*, is often thus found on the western coast of Ireland; E. T. BENNETT *Linn. Transactions*, XV. 1827. pp. 74—77.

principally, if not exclusively, of marine plants (*Fuci, Conferva*); according to others it would seem to live on Molluscs, but the fragments of shell, often found with considerable quantity of sand in the intestinal canal, may have been contained in the sea-water swallowed, and need not by any means to be looked on as the remains of shell-fish that had been consumed.

Petrified shells of Sea-urchins are found in great numbers in secondary strata, particularly in the chalk-formation, the interior being usually filled with silicious earth.

* *Anus eccentric superior or inferior.*

α) *Mouth eccentric.* (*Genital pores* 4.) *Spatangoïdea* AGASS.

*Spatangus* KLEIN, LAM. Ambulacra circumscript, five or only four, the odd one (the anterior) being either little distinct or wanting. Test ovate or cordate, often at the fore-part furnished with a furrow proceeding from the summit.

Genera *Holaster, Hemipneustes, Micraster, Spatangus, Amphidetus, Brissus, Schizaster* AGASSIZ.

Some species of this division are fossil, and occur especially in the chalk-formation, others in tertiary deposits. Amongst the species now living, which chiefly belong to the genus *Brissus* AGASS. we note:

*Spatang. ventricosus*, RUMPH. *Amb. Rariteitk.* Tab. XIV. No. 1; this foreign species attains a very large size. To the proper genus *Spatangus* AGASS. belongs *Spat. purpureus*, BLAINV., *Actinol.* Pl. XIV., FORBES *Brit. Starf.* p. 182, in the North Sea and Mediterranean. The form is heart-shaped. Of this species MILNE EDWARDS has given an anatomical figure in CUVIER *R. Anim. éd. illustrée, Zoophytes*, Pl. XI. *bis.* See also some notices on the Anatomy of *Spatangus* in SCHWEIGGER'S *Handb. der Naturgeschichte der skelettl. ungeglied. Thiere*, s. 538, 539.

The mouth is in this genus without teeth. There are only four *ovaria* or *testes* present, as also only four *pori genitales.* PHILIPPI not long ago described three American species in which only three genital pores existed, and which he united under the name of *Tripylus.* See ERICHSON'S *Archiv f. Naturgesch.*, 1845, s. 344, &c. Tab. XI.

*Ananchytes* LAM. (exclusive of some species), AGASS. Ambulacra radiating and diverging from the vertex to the margin, not interrupted. Body irregular, oval or conoïd; test without a furrow to the anterior ambulacrum.

Sp. *Ananchytes ovata* CUV. and BRONGN. *Descr. géol. des environs de Paris* in CUVIER *Rech. s. l. ossem. foss.* II. 2 Pl. V. fig. 7, BRONN *Leth. géogn.* Tab. 29,

fig. 28. *Ananch. hemisphærica* Cuv. and Brongn. l. l. fig. 8, &c. All the species of this genus are fossil and belong to the chalk-formation. The casts of the internal cavity in Fire-stone (*nucleus, moule intérieure*) shew minute elevated points in place of the ambulacral pores; such a *moule* is the *Ananchytes pustulosa* Lam.

*Dysaster* Agass. (*Collyrites* Desmoul. in part, species of *Spatangus* and *Ananchytes* Auctor.) Test rotund or cordate, with ambulacra not interrupted, mouth sometimes almost central not transverse. Ambulacra above radiating from a double vertex, the three anterior confluent in the central part of the test above, the posterior ones above the anus.

Sp. *Dysaster carinatus, Spatangus carinatus* Bronn *Leth. géogn.* Tab. xvii. fig. 7, in the Jura-formation like most of the species of this genus. Comp. Desor in the 3d number of Agassiz *Monogr. d'Echinoderm.*, who describes 20 species, of which 17 are from the Jura-formation and 3 from the chalk-period. No species either of this genus or of *Ananchytes* has been discovered belonging to the present animal world; Agassiz places this genus in the following division, that of the *Clypeastroïdea;* its place cannot be determined with precision, before it is known whether teeth be present; still we are of opinion that it ought not to be separated from *Ananchytes*, but forms the transition between that genus and the following division.

*b) Mouth central or sub-central.* (*Clypeastroïdea* Agass.) *Spines little evolved, sometimes very small, resembling hairs.*

*Galerites* Lam. Body conoïd or sub-oval, plane beneath. Ambulacra in ten furrows in pairs from the vertex to the base, radiately inscribed, not interrupted. Anus in the margin, or beneath and near the margin. Genital pores four.

Genera: *Clypeus* Klein, Agassiz, *Discoïdea* Klein, Agassiz, *Galerites* Agass.

Sp. *Galerites albo-galerus* Lam., Cuv. *R. Ani., édit. ill. Zooph.* Pl. xiv. fig. 4, Bronn *Leth. géogn.* Tab. xxix. fig. 18, Agass. *Monogr.* 3e Livr. Tab. i. f. 4—11, Tab. xiii. f. 7, &c. This genus consists of fossil species of the Jura and especially of the chalk-period. Comp. on this and some other genera Desor in the 3d number of Agassiz *Monographies d'Echinod.* already referred to.

*Pygaster* Agass. Body depressed, with outline orbicular or sub-angular, beneath concave. Anus large, superior, situated in a broad furrow. Genital pores four.

All the species of this genus are fossil; most of them belong to the Jura-formation.

*Nucleolites* LAM. Body ovate or cordate, convex, sub-irregular. Ambulacra five, extending radially from the vertex to the base, not interrupted. Anus superior, near the margin.

All the species are fossil, partly from the secondary, partly from the tertiary formation.

*Cassidulus* LAM. Body irregular, elliptic, ovate, or subcordate. Ambulacra five, circumscript, resembling a pentapetalous flower. Anus superior, near the margin.

This genus also consists of fossil species from different formations; *ex. gr.* from the chalk formation is *Cassidulus lapis cancri* LAM., FAUJAS DE ST FOND, *Besch. van den St. Pietersberg*, Pl. 30, fig. 1; BRONN *Lethæa géogn.* Tab. XXIX. fig. 20.

*Fibularia* LAM. *Echinocyamus* LESKE. Body sub-globose, with outline oval or orbicular. Ambulacra five short, circumscript. Anus inferior near the mouth, or median between the mouth and the posterior margin.

Sp. *Fibularia ovulum* LAM., GUÉRIN *Iconogr. Zooph.* Pl. III. fig. 5, *Echinocyamus pusillus* MUELL., FORBES *Brit. Starf.* pp. 175, &c. From the Atlantic Ocean, of the size of a pea. Amongst the foreign species, according to VAN PHELSUM, mostly American, we note *Fibularia craniolaris*, V. PHELSUM *Gewelvslekken* Tab. I. f. 16—35. Also in the chalk-formation and in tertiary deposits species of this genus occur.

*Echinoneus* LESKE, LAM. Body sub-ovate or orbicular, sub-depressed. Ambulacra inscribed radially in ten furrows from the summit to the base, not interrupted. Anus inferior, oblong, near the mouth. Genital pores four.

Sp. *Echinoneus semilunaris* LAM., GUÉR. *Iconogr. Zooph.* Pl. III. fig. 2, CUV. *R. Anim. éd. ill., Zoophytes*, Pl. XIV. fig. 1, from the West Indian Sea, &c. Of this genus no fossil species are known.

*Clypeaster* LAM. Body oval or sub-angular. Ambulacra circumscript radiating from the summit, resembling a pentapetalous flower. Anus inferior, near the margin, or in it. Genital pores mostly five.

Sp. *Clypeaster rosaceus, Echinus rosaceus*, L. KLEIN *Dispos. Echinod.* Tab. XVII. fig. A, Tab. XVIII. fig. B, BLAINVILLE *Actinol.* Pl. XVII.; from the Indian and Japan Seas. The shell is thick, and parted internally by pillars; comp. the figures in KLEIN l. l. Tab. XXVIII. XXIX. Fossil species also from the tertiary formations are known.

*Echinolampas* GRAY, AGASS. Ambulacra circumscript, very wide at the summit, narrower towards the margin, not conjoined. Disc submarginate forwards. Genital pores four.

Sp. *Clypeaster eccentricus, Echinolampas Kleinii* BRONN *Leth. géogn.* Tab. XXXVI. fig. 10: fossil from the tertiary formations, &c.

*Scutella* LAM. Body flattened, with margin thin, sub-acute. Ambulacra short, circumscript, resembling a pentapetalous flower. Anus inferior between the mouth and the margin. Genital pores four or five.

From this genus AGASSIZ at first separated the sub-genus *Echinarachnius* (*Prodrome d'une Monogr. des Radiares*, &c.,) afterwards he divided the genus *Scutella* of LAMARCK into thirteen *genera* (*Monogr. d'Echinod., 2e Livrais. les Scutelles*); *Rotula* KLEIN, AGASS., *Runa* AGASS., *Mellita* KLEIN, *Encope* AGASS., *Lobophora* AGASS., *Amphiope* AGASS., *Scutella* AGASS., *Echinarachnius* V. PHELS., *Arachnoides* KLEIN, *Scutellina* AGASS., *Laganum* KLEIN, *Echinocyamus* V. PHELS., *Moulinia* AGASS.

Sp. *Scutella sexforis* LAM., *Mellita hexapora* AGASS., GUÉRIN *Iconogr. Zooph.* Pl. 3, fig. 4, CUV. *R. Ani. éd. ill., Zooph.* Pl. 15, fig. 1. AGASS. *Monogr.* Livr. 2, Pl. IV. fig. 4—7, Pl. IV$^a$. fig. 11, 12; from the shores of the Moluccа Islands, &c.—*Scutella dentata* LAM., *Rotula Rumphii* KLEIN, AGASS., RUMPH. *Amb. Rariteitk.* Tab. XIV. fig. 1, &c. (LINNÆUS comprehended all the species known to him under the name of *Echinus orbicularis*). Except a very small number from the chalk-formation, all the fossil species of this genus are from the tertiary formations.

** *Anus superior central, opposite to the mouth. Test regular. Ambulacra, perfect. Genital pores, five.* (*Cidaridea* GRAY, AGASS.)

*Echinus* LAM. (spec. of genus *Echinus* L.) Ambulacra wider towards the middle of the test, divergent, contracted at the summit and towards the mouth. Spines placed upon imperforate tubercles, sometimes very long.

Sp. *Echinus lividus* LAM. (*Echin. sexatilis* TIEDEM. l. l.), VALENTIN in AGASS. *Monogr. d'Echinod.*, Liv. 4, Pl. 1, BASTER *Natuurk. Uitsp.* I: Tab. XI. fig. 1—8, FORBES *Brit. Starf.* p. 167. In the Mediterranean and North Sea, &c. For the synonomy of the European species of Echinus comp. AGASSIZ in the preface to the fourth number of his *Monographies.*

*Arbacia* GRAY, AGASS., *Echinometra* BREIJN, GRAY, AGASS.

Sp. *Echinus mamillatus* L., *Echinometra mamillata.* RUMPH. *Amb. Rariteitk.* Tab. XIII. fig. 1, 2, CUV. *R. Ani. édit. illustr., Zooph.* Pl. XIII. fig. 1, East Indian Sea, &c.

*Salenia* GRAY, AGASS. (*Goniopygus, Peltaster, Goniophorus* AGASS.)

Comp. AGASSIZ, *Monogr. d'Echinod.* Livr. 1.

*Cidaris* KLEIN, *Cidarites* LAM. (*Cidaris*, *Diadema*, *Astropyga* GRAY, AGASS.) Ambulacra parallel. Tubercles sustaining the spines not perforate, often remarkable for their size.

Sp. *Cidaris verticillata*, GUÉR. *Iconogr. Zooph.* Pl. 3, fig. 1; in the Indian Sea, on the coasts of Timor, &c. Of this genus many fossil species also are known.

Family IV. *Holothuridea.* Body free, mostly cylindrical, covered with a coriaceous skin, furnished with calcareous particles scattered, reticulate. Mouth surrounded by retractile tentacles. Anus terminal, opposite to the mouth (Genus *Holothuria* L. exclusive of several species).

Comp. on this family:

G. J. JAEGER *De Holothuriis, Dissertatio inaug.* Turici, 1833, 4to. cum tab. J. F. BRANDT *Prodromus descriptionis animalium ab* H. MERTENSIO *in orbis terrarum circumnavigatione observatorum.* Fasc. I. Petropoli, 1835, 4to. pp. 42—62, GRUBE *Actinien, Echinodermen und Würmer des Adriatischen und Mittlemeers*, Königsb. 1840, 4to. pp. 33—42. There are many figures of European *Holothuriæ* in the *Zoologia danica* and of foreign species in LESSON *Centurie Zoologique*, Paris 1830, 8vo.

We have spoken above (p. 140) of the calcareous ring which may be considered as a vestige of a skeleton, and which serves for the attachment of the longitudinal muscles. The pieces of which this ring consists are toothed above, but they do not discharge the office of teeth, the food, as far as it undergoes separation and mastication previous to deglutition, being thus effected by the callous skin surrounding the mouth alone. *Holothuriæ* feed upon *conchifera* and other marine animals; TIEDEMANN frequently found shells entire and uninjured in the intestinal canal of *Holothuria tubulosa*, so that the molluscs appeared to have been dissolved in the shell and digested. The bits of shell and the other matters unfit for use and undigested are rejected from the *cloaca* with the water in expiration. We have indicated above the chief particulars respecting the internal structure.

See, besides, TIEDEMANN l. l., also the beautiful engraving from a preparation by HUNTER in *Catalogue of the Physiolog. Series of Compar. Anat. contained in the Museum of the Royal College of Surgeons*, Vol. I. London, 1833, Pl. III. pp. 250—254.

The numerous species of this family are separated according to the form of the Tentacles (LAMARCK, GRUBE), the position of the

feet or ambulacral tubes (CUVIER), or the union of both these characters (BRANDT) into many genera. The arrangement of BRANDT is circumstantial, and here and there rather artificial than natural. Regard ought also to be had to the *Habitus*. If the position of the Tentacles be made the chief point in the arrangement, animals will be separated which in their *habitus* are nearly allied. These tentacles are either branched like a tree, fingered, or shield-like, (*peltate*), *i. e.* they consist of a pedicle with an expansion which is disciform, often indented or arborescent. Their number is usually ten, or twice ten. Where eight tentacles seem to be present, sometimes on closer inspection two others, smaller and undeveloped, are found, (the sub-genera *Anaperus* and *Colochirus* of TROSCHELL[1]). In some no special internal respiratory organs are found (the genus *Oncilabes* of BRANDT; in most the arborescent respiratory organ exists which we described above in *Holothuria tubulosa*.

*Pentacta* GOLDF. (*Cladodactyla, Dactylota, Oncinolabes, Aspidochir* BRANDT). Feet equal, disposed in five, or, more rarely, in six rows longitudinal, parallel. Body cylindrical or quinquelateral, attenuated at both ends. Tentacles mostly ten, sometimes twelve or fifteen.

*a*) *Tentacles peltate.*

*Aspidochir* BRANDT. A genus unknown to me. Sp. *Aspidochir Mertensii*, in the island Sitcha (Tentacles 12).

*b*) *Tentacles ramose.*

*Cladodactyla* BRANDT (Tentacles 10).

Sp. *Pentacta Pentactes, Holoth. pentactes* MUELL. *Zool. dan.* Tab. 31, fig. 8, FORBES *Brit. Starf.* p. 213; *Pentacta frondosa, Holoth. frondosa* L., *Holoth. pentactes* ABILDG. *Zool. dan.* Tab. 108, figs. 1, 2, Tab. 124. FORB. *Br. Starf.* p. 209; in the European seas. *Pentacta doliolum, Actinia doliolum* PALL. *Spic. Zool.* Tab. XI. figs. 10—12. CUV. *R. Anim. éd. ill. Zooph.* Pl. 20, fig. 4. These species are called, from their external resemblance, *Sea-Cucumbers.*

*c*) *Tentacles digitate or pinnate.*

*Dactylota* BRANDT.

Sp. *Pentacta pellucida, Holoth. pellucida, Zool. dan.* Tab. 135, fig. 1.

(*Note.*—Here also is to be referred the genus *Ocnus* FORBES, *Brit. Starf.* p. 229.)

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[1] *Neue Holothuriengattungen* in ERICHSON'S *Archiv f. Naturgesch.* 1846, s. 60—66.

*Oncinolabes* BRANDT. Body covered all over with recurved hooklets. (Differs from *Pentacta* by defect of respiratory organs.)

*Thyone* OKEN, *Mulleria* FLEM. (not JAEG.) Feet equal, numerous, scattered through the whole body. Body cylindrical.

*a) Tentacles ramose, often unequal* (*Phylloporus* GRUBE, *Anaperus* TROSCH., *Orcula* TROSCH.)

Sp. *Thyone papillosa, Hol. papillosa, Zool. dan.* Tab. 108, fig. 5, FORB. *Brit. Starf.* p. 233; in the North Sea, &c.

*b) Tentacles peltate* (*Sporadipus* BRANDT).

Sp. *Sporadipus Ualanensis* BR. &c.

*Holothuria nob.* (Species of genus *Holothuria* L.) Feet of twofold structure and figure, some cylindrical, dilated at the tip, usually occurring in the abdomen only, others situated on the back, not dilated at the tip, emerging from warts on the back. Body cylindrical, or flattened in the abdomen.

*a) Tentacles peltate or umbellate usually 20* (*Stichopus* BR., *Diploperideris* BR., *Holothuria* BR., *Bohadschia* JAEG., *Mulleria* JAEG., *Trepang* JAEG.)

Sp. *Holothuria tubulosa, Fistularia tubulosa* LAM.; *Holothuria tremula* GMEL., CUV., BOHADSCH *de quibusd. Animal. marin.* 1761, Tab. VI., TIEDEMANN *Anat.* Tab. I., CUV. *R. Ani. éd. ill. Zooph.* Pl. 20, fig. 3; one of the largest of the species in the Mediterranean. Twenty tentacles, placed alternately in two circles, surround the mouth. *Holoth. argus, Bohadschia argus* JAEGER *de Holoth.* Tab. II. fig. 1, on the coasts of Celebes and Timor. *Holoth. edulis, Trepang edulis* JAEG., LESS. *Cent. Zool.* Pl. 46, fig. 2, GUÉRIN *Iconogr. Zooph.* Pl. 4, fig. 7; this species lives on the coral-reefs of the Molucca, Philippine and Carolina islands, and is fished up in large quantities with other species under the name of *Trepang*, to be dried and smoked and prepared with condiments for the use of the Chinese and Malays, who consider it an exceedingly nutritive and stimulating (*aphrodisiacum*) article.

*b) Tentacles ramose.*

Genera: *Cladolabes* BRANDT (tentacles 20), *Colochirus* TROSCH. (Tentacles ten, two smaller).

*Psolus* OKEN (in part). Feet equal, disposed on a ventral flat disc, on the back none. Tentacles ramose.

*Psolus* JAEG., BR. Body attenuated backwards, covered with skin rugose or scaly. Three rows of feet in the ventral disc.

Sp. *Psolus phantapus, Holoth. phantapus* L., *Zool. dan.* Tab. 112, FORB. *Br. Starf.* p. 203, GUÉR. *Iconogr. Zooph.* Pl. IV. fig. 1; in the North Sea.

*Cuvieria* PÉRON. Body often convex, covered with calcareous imbricated scales, plane beneath, beset with numerous feet.

*Psolus squamatus* MUELL. *Zool. danic.* Tab. X. fig. 1—3, GUÉRIN *Iconogr. Zooph.* Pl. 4, fig. 2, &c.

## ORDER II. *Apoda.*

Body covered with a coriaceous, sometimes soft, skin, destitute of ambulacral feet.

Family V. *Synaptinæ.* Body cylindrical, elongate. A calcareous ring around the œsophagus. Mouth crowned with tentacles.

Most writers unite these animals with the *Holothuriæ.* But beyond doubt they form a distinct family, of which, however, the structure has been made known to us only in a single *genus* by the investigations of QUATREFAGES.

*Liosoma* BRANDT. Tentacles peltate. Respiratory organs arborescent.

Sp. *Liosoma Sitchaense* BR.

*Chirodota* ESCHSCH. Tentacles digitate at the extremity. (Respiratory organs?) Skin thickish. Body vermiform.

Sp. *Chirodota discolor,* ESCHSCH. *Zoologisher Atlas* II. folio, Berlin, 1829, p. 14, Tab. X. fig. 2; *Chirod. verrucosa* ESCHSCH. *ib.* fig. 3, both from the North-west coast of America; these animals live in the sand and under stones on the shore, in situations which are not quite dry at ebb-tide. Here belongs also *Holoth. purpurea* LESS., *Centur. Zool.* Pl. 52, fig. 2, and *Holothuria digitata* MONTAGU, *Linn. Transact.* XI. Tab. IV. fig. 6. According to BRANDT there are situated on the mesentery small cylindrical bodies divided at the extremity, which are subservient to respiration.

*Synapta* ESCHSCH., *Tiedemannia* LEUCK. Tentacles pinnatifid. No arborescent respiratory organs. Skin very delicate, rough from hooklets extremely minute, calcareous.

ESCHSCHOLTZ named this genus (from *συνάπτω, adnecto*), on account of its adhering to the skin by means of small hooklets, which he compares to the appendages of the calyx of the Burdock (*Arctium lappa*). He found *Synapta mamillosa* on the coast of *Otaheiti, Zool. Atl.* II. Tab. X. fig. 1. To this genus belongs also *Holoth. oceanica* LESS. *Centur. Zool.* Pl. 35; *Holoth. radiosa, ibid.* Pl. 15; *Fistularia vittata* FORSK. *Icon. Rer. Nat.* Tab. XXXVII. fig. 2, &c. QUATREFAGES discovered a species in the sand at the Chausey Isles, which, in my opinion, has much resemblance to the last-named species of FORSKAL, and gave a detailed description of it. *Mémoire sur le Synapte*

*de Duvernoy* (*Synapta Duvernæa*), *Ann. des Sc. Nat.* 2e Série XVII. *Zool.* pp. 19—93, Pl. 2—5. Respiration is effected in the abdominal cavity, into which the water passes by five apertures between the tentacles. The hooklets, shaped like anchors, one-tenth millim. in length and less, are set on oval eminences of the skin, which are visible under the microscope alone. Other similar eminences are covered with cells which can evolve an extremely fine thread (nettle-organ?). These animals appear to endure wounding and extreme mutilation without being destroyed.

*Note.*—Ought the genus *Haplodactyla* GRUBE to be placed here? Tentacles cylindrical, simple. The author of the genus says nothing about feet. Five respiratory organs, laciniate, sub-arborescent. GRUBE II. p. 42.

*Molpadia* CUV. Body tending to cylindrical or sub-pentagonal, coriaceous, attenuated backwards. Tentacles short, cylindrical, simple. Mouth armed with an apparatus of calcareous particles.

Sp. *Molopadia holothurioides* CUV.; *Molop. musculus* RISSO, *Europ. mérid.* Tom. v. figs. 31, 32. Comp. CUV. *R. Ani.*, III. p. 241, BLAINV. *Man. d'Actinol.* p. 651.

Family VI. *Sipunculacea.* Body cylindrical, elongate. No calcareous ring around the œsophagus. Mouth provided with a retractile proboscis.

*Sipunculus* L. Body round, elongate, annulate. A papillated retractile proboscis, with incised tentacular border or coronet of simple tentacles surrounding the mouth. Anus a lateral aperture of the body, situated towards the anterior part.

Sp. *Sipunculus nudus* L., *Syrinx* BOHADSCH, *de quibusd. animal. marin.* Tab. VII. fig. 6, 7, FORBES *Brit. Starf.* p. 245, LEUCKART *Breves animalium quorundam Descriptiones*, Heidelbergæ, 1828, 4to. fig. 3, and especially GRUBE in MUELLER'S *Archiv.* 1837, Tab. X. fig. 1; in the seas of Europe, especially the Mediterranean. This animal can attain a length of more than one foot, exclusive of the proboscis, which is usually retracted. It is very contractile and sometimes shortens itself one-half. Longitudinal and circular bundles of muscle, visible through the skin, give it a latticed appearance. The intestinal canal is very long, making two bends backwards and forwards; the last ascending portion is wound spirally round the preceding piece. Two brown vesicles, connected with the propagation, terminate with fine apertures before and by the side of the anus. The nervous system presents two rings round the œsophagus, and a cord running on the abdominal surface, that gives off numerous branches, and is surrounded by a blood-vessel as by an envelope; see KROHN in MUELLER'S *Archiv.* 1839, s. 348. From this species *Lumbricus phalloides* PALL. *Spicileg. Zool.* X. Tab. I. f. 8, seems not to differ. *Sipunculus edulis*, *Lumbr. edulis* PALL. *ib.* fig. 7, is a species eaten by the Chinese.

FORBES gives the name of *Syrinx* to the species which have a short proboscis with an indented tentacular fold around the mouth, like *Sipunc. nudus*. In other species the proboscis is longer, and there is a ring of simple lancet-shaped tentacles round the mouth. Of these he forms his genus *Sipunculus*, which appears to agree with *Phascolosoma* LEUCK.

Sp. *Phascolosoma granulatum* LEUCK. l. l. fig. 5, from the Mediterranean, probably not different from *Ascosoma Blumenbachii*, *ibid.* fig. 5; *Sipunculus capitatus* RATHKE, *Nov. Act. Acad. Leop. Car.* XX. 1, Tab. VI. fig. 20, 21; *Sip. Bernhardus* FORB. *Brit. Starf.* p. 251; it lives, like the Hermit Crab, in the empty shells of Molluscs (*Strombus pes pelecani, Littorina, Turritella, Dentalium*, &c.)

*Priapulus* LAM. Body cylindrical truncated posteriorly. Proboscis retractile; no tentacles around the mouth. A branched pyramidal appendage hanging from the posterior part.

Sp. *Priapulus caudatus, Holothuria priapus* L., *Zool. danica*, Tab. XCVI. fig. 1, and CXXXV. fig. 2, FORBES *Brit. Starf.* p. 256. GUÉRIN *Iconogr. Zooph.* Pl. 5, fig. 1. It is supposed that the bundle of threads at the extremity of the body serves for respiration. This singular animal lives in the North Sea.

*Bonellia* ROLANDO. Body oval, contractile, with a long protensile proboscis, divided at the extremity into two laciniæ. Anus posterior, terminal.

See ROLANDO in *Journ. de Physique, de Chim., d'Hist. nat.* &c. Tom. XCV. Juillet, 1822, pp. 49, 59, av. fig. (*from the Mém. de l'Acad. de Turin*, Tom. XXVI. pp. 357, &c., Tab. XIV. XV.) The long proboscis was taken for a tail by this writer, the anus described as mouth; near the *anus* two trussed organs are situated (salivary organs according to ROLANDO), which correspond to the arborescent respiratory organs of *Holothuriæ*. The intestinal canal is narrow and long, with two loops and many undulations.

Sp. *Bonellia viridis* l. l. fig. 1, GUÉRIN *Iconogr. Zooph.* Pl. 6, fig. 1; *Bon. fuliginosa*. These two species were found by ROLANDO on the shore of Sardinia.

*Thalassema* CUV. Body cylindrical contractile. Proboscis short, with spoon-shaped appendage, or sulcated lacinia, undivided. Two shining uncinate setæ in the anterior part of the body, behind the proboscis.

* Body smooth posteriorly. *Thalassema* GAERTNER.

Sp. *Thalassema Neptuni* GAERTN., PALL., *Spicil. Zool.* X. Tab. I. f. 6, GUÉRIN *Iconogr. Zooph.* Pl. 6, fig. 2, FORBES *Brit. Starf.* p. 259. (Here also seems to belong the genus *Ochetostoma* LEUCK., Sp. *Ochet. erythrogrammon, Atlas zu der Reise* VON ED. RUPPELL, *Neue wirbellose Thiere des rothen Meeres*, 1828, Tab. II. fig. 3, *Holoth. eaouari* LESS. *Cent. Zool.* and GUÉR. *Iconogr. Zooph.* Pl. 4, fig. 6.

** Body armed posteriorly with zones of horny setæ. *Echiurus* Cuv. (*Echinurus*).

Sp. *Thalassema echiurus, Lumbricus echiurus* Pall., *Misc. Zool.* x. Tab. 1, fig. 1—5, Forbes, *Brit. Starf.* p. 263, Guér. *Iconogr. Zooph.* Pl. 6, fig. 3; on the coasts of the North Sea; this species is used by the fishermen for bait; it is flesh-coloured, here and there translucent blue and red; the spines are shining and yellow, as far as they project from the body. The orange-coloured intestinal canal is long, with many undulations and vesicular expansions. There are two long, brown, somewhat tortuous, cæcal tubes near the anus, and four white vesicles at the anterior part of the body, which belong to the procreative apparatus. The nervous system consists of a thread running along the intestinal cavity. The skin has much muscularity, so that when wounded it spirts out the contained water like a fountain, and then the intestines are forced out.

*** Body furnished anteriorly and posteriorly with zones of setæ; with belly in the middle plane and in front of the *anus scutate*. (Setæ at the sides of the scute; anal tubule conical, retractile.) *Sternaspis* Otto.

Sp. *Thalassema scutatus* Ranzani, *Sternaspis thalassemoides* Otto, *Nov. Act. Acad. Leop. Carol.* Tom. x. Tab. 50, Guérin *Iconogr. Zooph.* Pl. 6, fig. 4, from the Adriatic. Otto took the conical extremity incorrectly for the mouth; see the communication relative to the structure of this animal by Krohn in Mueller's *Archiv.* 1842, s. 426. Ranzani, who described it before Otto, rightly distinguished the two extremities of the body, and also figured the spoon-shaped *proboscis*, in which it resembles *Echiurus. Opuscoli scientifice* i. Bologna, 1817, 4to. pp. 112—116, Tab. iv. f. 10, 11.

# CLASS V.

## INTESTINAL WORMS (*ENTOZOA*)[1].

By Intestinal Worms are understood worms that live in other animals, (not necessarily in their viscera). Though not more correctly in point of language, they might, perhaps, be better named Internal Worms, which would be a literal translation of the word *Entozoa*. This class is by no means natural, for the animals included in it not only differ remarkably from each other in external form, but also in internal structure. The efforts that have been made hitherto to distribute the different orders and families of the *Entozoa* amongst the different classes of invertebrate animals have not been satisfactory. In this, as in so many other attempts to determine the affinities of animals, a certain external resemblance has been mistaken for correspondence of internal structure and of type of organisation, by which alone true affinities can be established. An unprejudiced inquirer will scarcely attach more value to a comparison of *Echinorhynchus* with *Sipunculus*, of *Cysticercus* with bladder-bearing Acalephs, &c. than to a comparison of bats with birds. Consequently we are compelled to retain the class *Entozoa*, however we acknow-

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[1] Compare on this class:

C. A. Rudolphi, *Entozoorum sive Vermium intestinalium Historia naturalis*, III. Tomi, c. tab. æn. Amstelædami, 1808—10, 8vo.

C. A. Rudolphi, *Entozoorum Synopsis, cui accedunt Mantissa duplex et indices locupletissimi*, c. tab. III. æn. Berolini, 1819, 8vo.

Dr. Bremser, *Ueber lebende Würmer im lebenden Menschen.* Mit IV. illum. Kupfert. Wien, 1819, 4to.

Bremseri *Icones Helminthum.* III. Fasciculi. Viennæ, 1823, folio.

J. Cloquet, *Anatomie des Vers intestinaux Ascaride lombricoide et Echinorynque géant.* Avec 8 pl. Paris, 1824, 4to.

A. Von Nordmann, *Mikrographische Beiträge zur Naturgeschichte der wirbellosen Thiere.* Istes Heft. Mit 10 Kupfertaf. Berlin, 1832, 4to.

F. Dujardin, *Histoire naturelle des Helminthes ou vers intestinaux.* Avec 12 pl. Paris, 1845, 8vo.

Other important, more special works of Mehlis, Creplin, Leuckart, C. Th. Von Siebold, will be indicated further forward. See also the article *Entozoa* of Owen in Todd's *Cyclopædia* II. pp. 110—144 (1837).

ledge it to be unnatural. RUDOLPHI, to whose investigation this part of Zoology is so greatly indebted, compares the class of the intestinal worms to a *Fauna*, a collection of animals that live in a certain region. Their country is the living body of other animals. Recent observations have, however, taught us that some species in the cycle of their developments, leave their country for a time. The radial type, which we observed in the former classes, particularly in the Polyps and Acalephs, is here wanting. All *Entozoa* approximate to the elongated form of the articulate worms, although in some of them that form, on account of a bladder to which they are affixed by their extremity, is not at first sight apparent. Special respiratory organs are wanting. Some are entirely without sex, and are propagated by gemmation; others are bisexual; in others the sexes are distinct.

We must premise something as to the division of the *Entozoa*. RUDOLPHI adopts five principal sections, which had been already distinguished by GOETZE and ZEDER before his time. The first is that of Cystic worms (*Cystica* from κύστις, a bladder). The body is compressed or cylindrical, the posterior part of it passing into a bladder; sometimes many such *entozoa* are fixed on one bladder. The head has suckers, a circlet of hooks, or four *proboscides* armed with hooks. No genital organs have been discovered; nor any intestinal canal. [These have been shewn to be imperfectly developed *Tæniæ*.] The second division contains the Tape-worms (*Cestoïdea*, from κεστός, a girdle, a band, εἶδος, form). They have an elongated, compressed or flat body that is mostly jointed. The head has suckers; all the individuals are bisexual; an intestinal canal is wanting. The third division is formed by the Suctorial Worms (*Trematodes*, τρηματώδης, perforate). The body is soft, compressed or roundish, and provided with one or more suctorial pores. The intestinal canal has in general only one opening, and is usually branched; it lies in the tissue (*parenchyma*) of the body, not in a free space. The genital organs of both sexes are united in the same individual. The fourth division is that of the Thorn-headed Worms (*Acanthocephala*, from ἄκανθα, a thorn, and κεφαλή, head); they have a cylindrical, pouch-shaped body. The sexes are distinct; an intestinal canal is wanting. The fifth division includes those intestinal worms which have an intestinal canal, with both mouth and anus, suspended freely in the cavity of the body. The

body is cylindrical. The sexes are distinct. They are named *Thread-worms* or *Round-worms* (*Nematoïdea*, from νῆμα, a thread, and εἶδος). CUVIER makes a distinct order of this division, that of *Intestinaux cavitaires;* all the remaining *entozoa* he unites in a second order under the name of *Intestinaux parenchymateux.* OWEN has denoted these two principal divisions of CUVIER by the names *Sterelmintha* and *Cœlelmintha*[1]. In our compressed description of the structure of the intestinal worms we shall avail ourselves of the names which we have explained.

In the cystic worms, the tape and thorn-headed worms, there is neither mouth nor intestinal canal; the nutriment is introduced by absorption of the skin. In the thorn-headed worms two parts are met with by the side of the sheath of the proboscis, usually of a flattened form, and very small anteriorly. These parts, called *Lemnisci*, are, according to RUDOLPHI, subservient to nutrition. They contain, according to the description of VON SIEBOLD, a finely granular parenchyma, and are very vascular.

In the suctorial worms the intestinal canal commences with an *œsophagus*, more or less long, which, at its fore part (*pharynx*) is surrounded by muscular walls. In those that have a sucker at the anterior extremity of the body, the oral aperture is situated at its bottom. The intestinal canal divides, below the *œsophagus*, into two branches, which have cæcal terminations backwards. In many species these branches do not subdivide[2]; frequently they expand at their termination. In other species these principal branches give off other branches. This is especially the case in the *Liver-fluke* of sheep (*Distoma hepaticum*), where the branches divide to such a degree that the whole canal has an arborescent appearance. The oral aperture performs also the office of *anus;* at least the Distomes, which are taken alive from the liver, and exposed to air or placed in water, reject by the mouth, entirely or in part, the brown fluid with which the intestinal canal was filled[3]. The genus *Pentastoma* or *Linguatula*, differs from all the other suctorial worms in the

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[1] TODD'S *Cyclopædia* II. p. 111.

[2] As in *Distoma perlatum* NORDMANN, *l. cit.* Tab. IX., *Distoma rosaceum, ib.* Tab. VIII., *Diplostomata* found in the vitreous humour of the eye of the Perch, *ib.* Tab. II. III., and in many others. See also MAIJER *Beiträge zur Anatomie der Entozoen.* Bonn, 1841, 4to.

[3] Comp. E. MEHLIS *Observationes anatomicæ de Distomate hepatico et lanceolato.*

structure of its intestinal canal as well as in other respects. On that account CUVIER and OWEN have with propriety removed it from this division in which RUDOLPHI placed it. The intestinal canal lies in a free cavity of the body, though covered by the coils of the oviduct, and ends with a distinct *anus*[1]. The position and form of the canal agrees with the same in the *Round-worms;* only in the œsophagus is there some difference, since this tube in the *Nematoïdea* runs from the mouth at the anterior extremity of the body backwards in the same plane with the intestinal canal, whilst in *Pentastoma* it ascends obliquely because the mouth is situated on the abdominal surface. In the *Nematoïdea* the œsophagus is muscular, and in many species wider at its termination. The intestinal canal that succeeds it is straight, and its whole course continues nearly of the same width. In *Ascaris lumbricoïdes* pedunculated pyriform vesicles are found, which adhere to the internal surface of the integument, and occupy the space between the skin and the intestinal canal.

A vascular system has been discovered in many entozoa. [Amongst the *Nematoïdea* BLANCHARD has described in *Ascaris megalocephala* CLOQUET two longitudinal vessels lodged in each of the lateral canals within the integument, which extend from one extremity of the body to the other. At about the depth of one third of the œsophagus, the two, supposed to be arteries, leave their tubes to form an arch behind the œsophagus; on the arch a small ampulla is seen which is supposed to supply the office of a heart. The two arteries descend in the tubes throughout the whole length of the body, and communicate with the two other longitudinal vessels supposed to be veins[2]. In the *tænia* the longitudinal canals, four or six in number, communicate by transverse branches, and open in the last joint into a pulsatile vesicle, which expels their contents in drops at intervals. In the suctorial worms the fine vascular network, hitherto considered to be a circulating system, has been shewn by VAN BENEDEN to be an appendage of the tubular system, which terminates in a vesicle that opens externally by a *foramen caudale*. The apparatus in the last two families of

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[1] See OWEN *Transact. Zool. Soc.* I. 1835, Pl. 41, fig. 12; DIESING *Ann. des Wiener Museums*, I. 1836, Tab. II. fig. 2; comp. Tab. I. fig. 20, of *Pentastoma proboscideum*.

[2] BLANCHARD *Ann. des Sc. nat.* 3e Série, *Zool.* Vol. XI. pp. 146, 147, and CUVIER *R. Anim. édit. illus. Zooph.* Pl. 26, fig. 1 *c*.

worms appears to be similar, and for the purpose of secretion; a renal secretion, as VAN BENEDEN supposes[1].] In the thorn-headed worms there are two lateral canals situated beneath the skin that run the whole length of the body.

We have already remarked that special respiratory organs are wanting. So far as any action occurs between the air of the medium in which these animals live and their nutrient fluid, it must be effected by means of the skin. But Entozoa live, for the most part, in situations where the atmosphere exists in a condition very impure and unfit for respiration; or where no air at all can enter, as in the liver, brain, kidney, &c. It is therefore probable that they derive from the fluids absorbed from the animals in which they live, the quantity of oxygen necessary for their life, and that they experience the influence of this gas only mediately through the animals in which they live[2].

With respect to propagation: no genital organs, as noticed above, have been detected in Cystic worms. What many writers have described as eggs in these worms are calcareous corpuscles beneath the skin, which also occur in Tape-worms. Their multiplication is effected by gemmation. In *Cœnurus* there arise on the bladder on which the worm, or that extremity of it that bears the head, is seated, little buds which again develop other buds; in Echinococcus new bladders are formed within the parent bladder, like cells within cells, in which young *Echinococci* are developed that continue hanging by a thread for a time, after the containing envelope is ruptured, and then fall into the cavity of the parent bladder[3]. In *Cysticercus* the mode of propagation is yet unknown. In *Trematoda* there is found on the abdominal surface, generally nearer to the anterior than the posterior extremity, an opening common to the organs of both sexes. From this a penis, usually named *Cirrus*[4], can be evolved; near this part the *vagina* opens.

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[1] VAN BENEDEN *Lettre relative à l'Hist. des vers cestoïdes, Ann. des Sc. nat.* 3e Série, *Zool.* Vol. XVII. pp. 21—30.

[2] Comp. on the respiration of intestinal worms, RUDOLPHI *Hist. nat. Entozoor.* I. pp. 239—244, and CLOQUET *Anat. des vers intestins*, pp. 42—44.

[3] MUELLER in the *Jahresbericht* for 1835, *Archiv.* s. CVII. CVIII.; V. SIEBOLD in BURDACH'S *Physiol.* 2te Auflage II. s. 183—185.

[4] See the fig. of *Distoma hepaticum* in MEHLIS, figs. 8, 9, 11. In fig. 8 is seen near the *cirrus* the opening of the *vagina*, through which a bristle has been passed to distinguish it.

The *testes* have mostly a rounded form; in *Amphistoma subtriquetrum* and *giganteum*, they are finger-shaped and branched[1]. From these testes, usually two in number, efferent vessels proceed to a seminal vesicle lying at the base of the penis in the Cirrus-sac (*receptaculum Penis*); from which a canal arises that runs to the penis. But besides this, one of the testes gives still a third *vas deferens* to a seminal vesicle lying further behind (*vesicula seminalis interior*), and from which arises a short tube connected with the oviduct[2]. Here self-impregnation may be effected: in which case the second *vesicula seminalis* and the external genital organs are difficult of explanation: unless we suppose that both self-impregnation and copulation are possible. In the female organs of the suctorial worms we would direct particular attention to that remarkable arrangement by which, according to V. SIEBOLD, the yolk and the germ (*vesicula germinativa*) are not produced in the same organ:—that here we must consequently, instead of ovary, distinguish a germ-stock and a yolk-stock. The lateral parts, usually dendritic or botruoïdal, which were formerly believed to be ovaries, are the yolk-stocks: the germ-stock is placed in the middle of the body, and has a roundish form. In the *Tape-worms* the two sexes are also united: and V. SIEBOLD suspects that in this case, also, the germ and yolk-stocks are distinct organs. In the jointed Tape-worms (*Tœnia*, *Bothriocephalus*) the sexual organs are situated in every joint, only the anterior more recent joints do not yet indicate them, because they become more perfectly developed in proportion as the joints are more posterior. These animals, therefore, during their growth present us with a successive repetition of the same organisation. Some authors think that every individual joint is to be considered as a suctorial worm, and the Tape-worm as a compound suctorial worm. The sexual openings are situated in every joint, either on the edge or in the middle. In *Bothriocephalus latus*, for instance, on the abdominal surface of the body there is a fold of skin in the middle of each

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[1] *Amphistoma triquetrum*, BOJANUS *Isis*, 1821, transferred to SCHMALZ *Tabul. Anatomiam Entozoor. illustr.* Dresdæ, 1831, Tab. VIII. figs. 7—9; *Amphistoma giganteum*, DIESING in *Wiener Annalen* I. Tab. XXII. figs. 9, 14, 15.

[2] V. SIEBOLD found this arrangement in many species of *Distoma*, and suspects that it occurs in all. See BURMEISTER on *Distoma globiporum* in WIEGM. *Archiv.* I. 1835, s. 187; V. SIEBOLD, *ibid.* II. 1836, s. 217, Tab. VI., and in MUELLER'S *Archiv.* 1836, s. 235—237, *Distoma nodulosum*, Tab. X. fig. 1.

joint, yet nearer the anterior edge, with two openings: through the anterior and larger the penis is evolved; the posterior smaller is the female sexual opening: round both of them are minute white points which ESCHRICHT[1] concluded, under high powers of the microscope, to be follicles (mucous crypts of the skin). The eggs of *Bothriocephalus* have a hard shell, as in the *Distomes*, of a brown or brownish-yellow colour, and seem like them to spring open with a sort of hood. In the thorn-headed and round-worms the sexes are distinct, and may be often recognised externally by their different form and size. In the thorn-headed worms the sexual organs fill the greater part of the cavity of the body. From the sheath that surrounds the proboscis there runs backward in the axis of the body a band-like structure, which has been erroneously supposed to be a canal, but which is for the support of the organs that prepare the germ or the seed (*ligamentum suspensorium*); VON SIEBOLD supposes that even the ovaries are developed in this organ. These ovaries are found free in the abdominal cavity, as masses of oblong-round eggs: the eggs become detached as they advance in development. The muscular oviduct terminates in a very small opening, scarcely visible at the posterior part of the body: it has at its anterior extremity an infundibular expansion which alternately widens and contracts, and takes up the eggs that were floating freely in the cavity of the body and moves them onwards[2] to the oviduct. This arrangement, in virtue of which the oviduct opens freely into the cavity of the abdomen and is not an immediate continuation of the ovary, is found in most vertebrates, with the exception of the osseous Fishes, but has not hitherto been observed in invertebrates except in *Echinorhynchus*. In male thorn-headed worms there are usually two *testes* lying one behind the other. The penis lies in a sac having a conical appendage that can be everted from the body in the form of a little bell.

Amongst the Thread-worms the males are less frequent than the females: they are smaller and more slender, and may frequently be

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[1] See ESCHRICHT *Anatomisch-physiologische Untersuchungen ueber die Bothriocephalen; Act. Acad. Cæs. Leop. Carol. Nat. Curios.* Vol. XIX. Supplem. II. 1840.

[2] VON SIEBOLD in BURDACH'S *Physiologie*, II. s. 197. See a figure in BUROW *Echinorhynchi strumosi Anatome*. Diss. Zootom. Regiomonti, 1836, 8vo. fig. 1 *g*. fig. 6; comp. DUJARDIN op. cit. p. 494, Pl. VII. fig. 7, D 5. (*Echinorhynchus anthuris*, a species from the freshwater Salamander).

recognised by their curved extremity or by the sexual organ externally visible; this penis is in most species double, in *Tricocephalus* and *Trichosoma* single. The organ which prepares the germ or seed has the form of a slender convoluted canal. It is single in the males: in the females, with few exceptions, it is double. These canals are of great length: according to CLOQUET, in the male *Ascaris lumbricoïdes* when quite unravelled it measures from $2\frac{1}{2}$—3 feet, and in the female each of them measures 4—5 feet. The different divisions of the canal may be considered to be ovary or testis, and *vas deferens* or oviduct with *uterus*. The terminal portion in the female is distinguished as uterus by its greater circumference and its vigorous peristaltic motion. A very wide, longish sac-shaped structure at the termination of the canal in the male is to be considered as *vesicula seminalis*. The external sexual opening is, in the male, always situated at the posterior extremity of the body; in the female ordinarily further forward, and in some species in the middle, or towards the anterior extremity[1]. Non-sexual Nematoïds are met with[2]; CREPLIN gives it as a general rule that a Nematoïd living in a perfectly closed cyst, or shut up on every side by a membrane, never has sexual organs. It has been suspected that these species are in an incomplete state, and can attain their perfect development only in other localities[3].

We here approach what, until very recently, was one of the most obscure problems in the economy of the Entozoa: and MIESCHER was fully justified in his remark that many of the observations relating to their development are riddles of Natural History[4]. [With respect to the suctorial worms our information is in fact only fragmentary: yet since the observations refer to very different periods of their development in different Trematodes, we are able from analogy to collect a tolerably connected history of the whole process in any one of the class.] It is well known that the

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[1] In *Ascaris lumbricoïdes*, these parts are figured in the work of CLOQUET already cited, Pl. II. figs. 8—10, Pl. IV.

[2] VON SIEBOLD, WIEGM. *Archiv f. Naturgesch.* IV. I. 1838, s. 302—312; CREPLIN, *ibid.* s. 273.

[3] MIESCHER, however, has observed ovaries in *Filaria Piscium*. WIEGMANN'S *Archiv.* 1841, II. s. 301.

[4] F. MIESCHER *Beschreibung und Untersuchung des Monostoma bijugum*. Basel, 1838, 4to. s. 24.

Danish zoologist MUELLER classed amongst his Infusories minute worms with tails, to which he gave the generic name of *Cercaria*. The accurate observations of NITZSCH taught us to define the genus more completely, and supplied a lively picture of the form and movements of a worm that to the naked eye seems like a moving point[1]. He compared these animals to Distomes that have had a tail-like appendage attached to them, and their motions to those of a *Vibrio:* each of these structures, the body and the tail, had a separate motion: when the body moved on by creeping and sucking the tail was at rest; and, conversely, when the tail undulated rapidly it forced along with it the body, which seemed now to have no independent motion of its own. NITZSCH further saw that *Cercariæ* cast their tail, and observed in *Cercaria ephemera* that it fixes itself, covers itself with a shell that presently hardens, and thus becomes, as it were, a pupa. Such pupæ remain unchanged for months: what was to succeed remained unknown. Afterwards similar observations were made by others, particularly by VON SIEBOLD. STEENSTRUP[2] shewed that the pupæ change into Distomes after the lapse of several months. *Cercariæ* live as parasites within the bodies of different Molluscs, as *Lymnæus* and *Planorbis*. But this does not terminate the surprising series of these changes. *Cercariæ*, the larvæ of Distomes, do not arise immediately from the eggs of these last. Within the above-named Molluscs, and in some others, little bags of an oblong form (*germ-pouches*) are found, in which a peculiar organisation and motion may sometimes be traced, but which in other species are motionless, and contain *Cercariæ* in a more or less advanced state of development. Considered as parasites of the germ-pouches, these have been named parasites of the second order: yet they are not parasites, but the progeny of these vermiform germ-pouches[3]. How these last originate from the young of Distomes has not been absolutely ascertained. The young animals,

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[1] C. L. NITZSCH *Beitrag zur Infusorienkunde*, Halle, 1817, 8vo.

[2] STEENSTRUP *Alternation of Generation*. Translated by BUSK for Ray Soc.

[3] BOJANUS, who discovered such vermiform germ-sacs of a yellow colour in *Limnæus stagnalis*, named them *King's yellow worms; Isis*, 1818, s. 729. The celebrated V. BAER published many similar observations in *Nov. Act. Cæs. L. C. Nat. Cur.* Vol. XIII. P. 2, pp. 605—659, Taf. XXXI.; as also the far-famed investigator of the lower animal forms V. SIEBOLD in BURDACH'S *Physiol.* 2te Ausgabe, s. 186, &c.

that proceed from eggs of Distomes, move rapidly by means of cilia with which their body is covered like that of many Infusories. In such a young animal VON SIEBLOD saw in *Monostoma mutabile* a parasite lodged which agreed in form with that of the germ-pouch of *Cercaria echinata*. [He concludes that the germ-pouch is thus shewn to be the descendant of a Trematode. The *Monostoma mutabile* is a parasite of water-birds and lives in cavities of their body which communicate with the external world. If a *Monostoma mut.* has produced an embryo, this can readily escape from the abode of its parent into the water, and may by means of its cilia find instinctively the animal suited to supply a fit residence for the further development of the germ-sac which it contains. It may pass into the interior of that animal by some one of the natural openings. Having now fulfilled its office of a living envelope to the germ-pouch, the ciliated embryo will die, and the germ-pouch seeks by perforation that situation within the body of its host which is suited to its further growth, and to the supply of due nutriment for the Cercaria-brood which it contains. The greater number of suctorial worms are, when they have gained their sexual organs, parasites of the higher vertebrates. How then can *Cercaria* effect an entrance into the body of such vertebrates as never come near the waters in which they live? VON SIEBOLD has given a probable answer to this enigma. He very commonly found in the aquatic larvæ of *Ephemeridæ*, *Phryganidæ*, *Libellulidæ*, &c., as well as in the perfect insects, encysted *Cercariæ* which had divested themselves of their tail, and which in fact were larval trematodes. In order to effect a passive migration into the vertebrate in which their development is to be completed, they must wait until their temporary host is swallowed by some insectivorous land bird or mammal[1].] Though there still remains an ample field for conjecture and fancy, thus much may be concluded from the observations hitherto made, that in these animals (as in Medusæ, vid. pp. 100, 101) a succession of alternate generations occurs: that the first series does not resemble the parent, but that from it young ones proceed which return to the original form. The germ-pouches constitute the first series, the nurses (*nutrices*); they are the starting-point of animals to be born as

[1] Comp. VON SIEBOLD *Die Band u. Blasen-würmer*, Leipsig, 8vo. 1854, pp. 21—31.

larvæ, *Cercariæ*, from the larval state to be changed into pupæ, and from this finally to become Distomes[1].

Besides these changes of Distomes, of which the entire series, in its chief features at least, has been investigated, there are others relating to *Tæniæ* which [until lately] were only observed fragmentarily. Such was that of LEBLOND, who found in the peritoneum of *Muræna conger* a worm enclosed in a cyst and containing a young *Tetrarhynchus*. He described this larva of *Tetrarhynchus* as a species of *Amphistoma* and the *Tetrarhynchus* as its parasite[2]. MIESCHER also made similar observations. Sometimes the successions of development appear to be possible only on change of abode. The simple *Ligulæ* of fishes are found, according to RUDOLPHI, in birds that feed on fishes in their more perfect form and furnished with developed sexual organs: the worms of the [supposed] genus *Scolex*, that live in *Pleuronectæ*, are probably changed in the bodies of Rays and Sharks into *Bothriocephali*, and the *Bothriocephalus solidus*, that lives in *Gasterosteus pungitius*, is changed, according to ABILDGARD[3] and CREPLIN, into the *Bothriocephalus nodosus* of water-birds (*Mergus*, *Colymbus*, &c.), which feed on that fish. That worms should thus continue to live in other animals becomes less surprising when we consider their tenaciousness of life; *Ligulæ* have been found alive in under-cooked fish; RUDOLPHI found individuals of *Ascaris speculigera* stiff and hard in the gullet and stomach of a Cormorant that had been kept for eleven days in spirit of wine which returned to life in warm water: and MIRAM saw individuals of *Ascaris acus* from the Pike dry and sticking to a board revived by water, and in some instances moving a part which had imbibed the fluid whilst the rest continued shrivelled up and adhering immoveably to the board[4].

These observations prove, by the way, that it is not necessary to have recourse to equivocal generation in all cases of *Entozoa* where their existence appears to be inexplicable by the ordinary mode of propagation.

[Tape-worms attain their full development and mature sexual

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[1] See STEENSTRUP *Alternation of Generation*.

[2] *Ann. des Sc. nat.* sec. Série. Tom. VI. *Zool.* pp. 289—295, pl. 16, f. 1—5.

[3] RUDOLPHI *Entozoor. Hist. Nat.* II. P. II. pp. 60, 61.

[4] WIEGMANN'S *Archiv f. Naturgesch.* 1840, I. s. 35—37.

organs only in the intestinal canal of vertebrate animals: when found in other viscera of these animals, or in the interior of inferior creatures, they are always immature. The ova, however, of Tape-worms are never developed in the intestine of the animals which harbour the parent worm: still the embryo is so far advanced within the ovum contained in mature joints when discharged from the intestine that its form may be distinguished. In all instances the armature of the embryo is the same, however different it may be in the heads of fully developed worms of different species. Thus the embryos of *Tænia* and of *Bothriocephalus* have both of them six hooklets, though the head of a developed *Tænia* is armed with a coronet of numerous hooklets and that of *Bothriocephalus* is unarmed. These six hooklets are not all of the same form: the pair in the middle are not curved at the extremity like the others, they are straight, very finely pointed, thinner throughout and also longer than the other four, which are also disposed in pairs. The middle pair are for penetrating soft tissues, and the rest for helping the embryo forward when it has once penetrated them. STEIN[1] saw these embryos free within the intestinal canal of larvæ of *Tenebrio molitor* and encysted on the outside of the canal, and justly concluded that the latter had perforated the canal from the interior, having entered by the mouth. The future tape-worm does not appear to arise from the embryo by metamorphosis, but to be formed within it by gemmation, whilst the six teeth of the embryo are rejected when they have performed their office and are found dispersed on its outer surface. A bud is seen within the embryo, which gradually assumes the special form of the head and neck of the future Tape-worm. As the development proceeds the head and neck would be permanently enclosed within the embryo in which it is being formed, were it not that at the same time a canal from the exterior is formed around them, so far as to allow the head and neck to be produced when the larva is freed from its cyst. It is then found that the neck of the larva is continuous with the body of the embryo, which forms a vesicle at its extremity. To this larva of a *Tænia* the name of *Scolex*, proposed by VAN BENEDEN, is now appropriated by the common consent of Helminthologists. If now

[1] STEIN, in SIEBOLD and KOELLIKER'S *Zeitschr. f. wissenschaft. Zool.* IV. 1853, s. 407.

the *Scolex* can gain a passive migration into the intestinal canal of an animal suitable for its development, that development will proceed; the vesicle will be cast off: joints will be formed successively beneath the neck, and in these joints the genital organs will be developed, the joints first formed, or nearest the posterior extremity of the body, being the first to become mature. Thus the *Scolex* is changed into a Tape-worm. Many naturalists now consider the Tæniæ to be compound animals, (which indeed was the opinion long ago of VALISNIERI and COULET and afterwards of BLUMENBACH,) colonies, like certain Polyps: the head and neck corresponding to the Polyp-stock, and the joints, under the name of *Proglottis*, to the single Polyps. By such observations as these VON SIEBOLD has been enabled to interpret justly those of LEBLOND and MIESCHER alluded to above. The *Amphistoma* of LEBLOND was the embryo of the Tape-worm, now the *receptaculum Scolecis*, the *Tetrarhynchus* the *Scolex* of a *Rhyncobothrius*. When the minuteness of these embryos is considered (they are not more in volume than the blood-disc of the frog) it is not difficult, as VAN BENEDEN[1] says, to comprehend that they may perforate the walls of the intestine to encyst themselves beneath the peritoneum, or to penetrate the vessels and distribute themselves with the blood in different viscera of the body, not excepting the brain itself, or the humours of the eye. Dr HAUBNER of Dresden caused six young lambs to swallow the living and mature joints of *Tœnia serrata*. They all died of the peculiar vertiginous disease produced by *Cœnurus cerebralis*. The *Cœnurus* vesicles were found in the brain, and the heart, lungs, and voluntary muscles abounded with encysted broods of *Tœnia*[2]. It would seem from this that the different forms of *Cœnurus* and *Cysticercus* assumed by the larva depend upon the locality occupied by the embryos, and the quantity and nature of the nutriment which they obtain there. And this conclusion is confirmed by the previous and converse experiments of VON SIEBOLD. On causing young dogs to swallow *Cystic. pisiformis* from the liver of the hare, *Cist. tenuicolles* from the mesentery of the sheep, *Cist. cellulosa* from the muscles of the swine, *Cœnurus cerebralis* from the brain of the sheep, the same form of *Tœnia*, viz.

[1] VAN BENEDEN *Ann. des Sc. natur.* Série III. *Zoolog.* Vol. XX. pp. 320, 321.

[2] VON SIEBOLD *Band u. Blasen-würmer*, 8vo. Leipsig, 1854, p. 106.

*Tænia serrata*, which in its developed state resides in the small intestine of the dog, was found in all cases. The experiments were performed so frequently, and with such precautions as to render the results incontestable[1]. The cyst is a secretion of the infested animal, and derives its blood-vessels from it.

There is reason to conclude that a nervous system exists in most Entozoa. In *Bothriocephalus* BLANCHARD describes a small ganglion on each side of the head (probably connected by a transverse band), which sends a fine thread forwards and backwards; but he was not able to detect the distribution of these[2].] No nerves have been discovered in the incomplete cystic forms. In Distomes, and various other suctorial worms, two small ganglia have been seen near the mouth, which are united by a transverse band that runs over the œsophagus. From these two threads arise that have a parallel course through the body, become finer backwards, and give off some lateral branches[3]. In the thorn-headed worms there is, according to the investigations of VON SIEBOLD, in different species of *Echinorhynchus*, a nervous mass at the base of the proboscis, from whence threads radiate in all directions, whose course is not easy to follow. In *Pentastoma* a large nervous ganglion lies beneath the œsophagus, from which a nervous ring arises that runs transversely above the œsophagus; small branches go from the ganglion to the muscles of the mouth and the surrounding parts, and two threads proceed longitudinally, one on each side, backwards, giving off fine branches, and, at last, losing themselves in the muscular tissue[4]. In *Strongylus gigas* the nervous system forms a flattened ring round the commencement of the œsophagus, and a string running backwards in the middle of the abdominal surface, which ends in a ganglion close by the anus. From the string arise at short and nearly equal distances transverse nervous threads. Special organs of sense are not found in the intestinal worms, with

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[1] See *Band u. Blasen-w.* s. 80—95.

[2] BLANCHARD *Ann. des Sc. nat.* 3e Série, *Zool.* Vol. XI. pp. 113, 114, CUVIER *édit. illus. Zooph.* pl. 26. fig. 1*d*.

[3] MEHLIS *Observat. anat. de Distomate;* DIESING in *Amphistoma giganteum, Wiener Annalen* I. p. 146, Tab. XXII. fig. 16, &c.

[4] OWEN *Transact. of the Zool. Soc.* I. pl. 41. fig. 13; TODD *Cyclop.* l. l. p. 130, fig. 78 in *Pentastoma tænioïdes;* DIESING *Wiener Annal.* I. Tab. II. figs. 7, 19, in *Pentast. proboscideum.*

the exception of those of touch about the mouth in certain thread and suctorial worms, such as threads, papillæ, or tentacles, which can be extended by eversion.

A special muscular system is usually present, but the muscular fibres are not always united into bundles to form distinct muscles. In the suctorial worms the muscular fibres in their entire course are completely united and interwoven with the rest of the mass of the body[1]. In the tape-worms fibres are visible beneath the skin running longitudinally. In the thread and thornheaded-worms two layers of muscular fibres may be distinguished beneath the skin, the one longitudinal, the other transverse. The proboscis of Echinorhynchus has special muscles for its inversion and production.

The Trematodes make use of their suckers, especially the posterior, for fixing themselves. Other intestinal worms have spines or hooks for that purpose, which are movable, and often possess considerable hardness. It is probable that these hooks cause by their irritation an increased afflux of fluids, whereby the nutrition of the worm within the animal that harbours it is facilitated.

Entozoa are inhabitants of very different classes of animals; the most numerous are the species which occur in birds and fishes. Amongst the tape-worms especially are genera, which are found exclusively or principally in fishes; nearly all the species of the genus Bothriocephalus occur in fishes; of *Tænia*, on the other hand, more than half the numerous species occur in birds, very many in mammals, in fishes very few. Of the genera *Distoma* and *Echinorhynchus* so rich in species, by far the most of these are found in fishes and birds. The genus *Cysticercus* appears to occur almost exclusively in mammals, as also *Echinococcus* and *Cœnurus*. Of the genus *Ascaris* all the classes of Vertebrates have many species; of *Strongylus* especially the mammals. The four genera, *Distoma*, *Tænia*, *Ascaris* and *Echinorhynchus*, contain the greatest number of the known species of intestinal worms, especially the three first. Entozoa live in all parts of the body, but mostly on mucous membranes, in the intestinal canal and the lungs. Even in the heart and the blood-vessels some species occur.

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[1] See DIESING, op. cit. Tab. XXI. figs. 4—8 in *Amphistoma giganteum*.

# SYSTEMATIC

# ARRANGEMENT OF ENTOZOA.

## CLASS V.

## ENTOZOA.

ANIMALS mostly elongate, without peculiar organs of respiration, parasitic, occurring in various internal parts of other living animals, sometimes destitute of nervous system, or having a nervous ring surrounding the mouth and a single ventral or double lateral cord.

### ORDER I. *Sterelmintha* s. *Parenchymatosa.*

Intestinal canal wanting in some, vascular in others, surrounded by the parenchyme of the body.

Family I. *Cestoïdea.* Body elongate, depressed, soft, continuous or articulate. Mouth none; head usually furnished with fossettes or suctorial oscules. All the individuals hermaphrodite.

*Caryophyllæus* GMEL., *Caryophyllus* BLOCH. Body continuous (not divided into segments), depressed, with head dilate, lobate or laciniate, mutable.

Sp. *Caryoph. mutabilis* RUD., *Entozoor. Hist. nat.* Tab. VIII. figs. 16—18, BREMSER, *Icon. Helminth.* Tab. XI. figs. 1—8; this species lives in fresh-water fishes (*Cyprinus, Cobitis*). *Caryophyllæus* is distinguished from the rest of the tape-worms by the occurrence of the genital organs only once, whilst in the rest, on the contrary, they occur repeatedly behind each other in the length of the body.

*Ligula* BLOCH. Body continuous, depressed, extremely long, in the imperfect state with neither head nor genitals conspicuous, with a median or two lateral furrows running lengthwise; in the

developed state with head furnished on both sides with an extremely simple fossette, and with single or double rows of ovaries.

Sp. *Ligula simplicissima* BREMS., *Icon. Helminth.* Tab. XII. fig. 1; in different species of fresh-water fishes in the abdominal cavity (*Fasciola intestinalis* L., *Der Riemenwürm, Fischrieme, Strap-worm.* It is difficult in this state to distinguish the species: in *Cyprinus carassius,* CREPLIN found a species with two longitudinal streaks, *Ligula digramma.* The *Ligulæ* met with in birds have one row or two of genital organs: *Ligula uniserialis* RUD., *Entozoor. Hist. nat.* Tab. IX. fig. 1. [In fact *Lig. simplicissima* of fishes is the undeveloped state of *Lig. spársa* or *Lig. serialis* of water-fowls. VON SIEBOLD *Band u. Blasen-würmer,* s. 41.]

*Bothriocephalus* RUD. Body elongate, depressed, articulate. Head somewhat tumid, oval or sub-quadrangular, with two or four opposite *bothria* or fossettes.

Comp. F. S. LEUCKART, *Zoologische Bruchstücke* I. Helmstadt, 1819, 4to. mit 2 Kupfert. D. F. ESCHRICHT *Anatomisch-physiolog. Untersuchungen über die Bothriocephalen,* mit 3 Kupfer. 1840, 4to. (a reprint from the *Act. Leop. Carol.* Vol. XIX. Supplem.)

Sp. *Bothriocephalus latus* (*Tænia lata* of Authors). BREMSER *Ueb. leb. Würmer,* Tab. II. f. 1—12, *the broad Tape-worm;* this species lives in the small intestines of man, and attains sometimes a length of twenty feet; it is especially met with in Russia and Switzerland, in Germany and Holland less frequently. Comp. below, on *Tænia solium.*

*Bothriocephal. punctatus* RUD., LEUCKART, *Zool. Bruchstücke* I. Tab. I. f. 16, Tab. II. fig. 40, ESCHR. l. l. Tab. III. figs. 18—28; in the Turbot and other species of *Pleuronectes,* and in other marine fishes, especially in *Cottus scorpio.* The several joints are multiplied by transverse partition, just as a multiplication of individuals takes place in *Naïs* by growth. The transverse partition commences before the genital organs are developed. The young animals consist of a head and a small number only of joints. Probably each animal performs annually a determinate circuit of development. When it has cast off its joints mature and full of eggs in the summer or autumn, new joints begin to grow; in winter no eggs are found, and even occasionally in large individuals no developed genitals. Probably a similar renewal of the animal occurs also in *Bothriocephalus latus* (and in *Tænia*), when the new joints are developed in the part that succeeds the head, the so-called neck, which becomes marked off in joints. In this way may be explained what ESCHRICHT observed in a sufferer from *Bothr. latus,* that amongst the pieces cast off, the subsequent piece did not fit on to that which had preceded, but on the contrary was similar to it; narrower and more imperfect joints had in the meantime been developed into broader.

Sub-gen. *Schistocephalus* CREPL. Head triangular, obtuse, bifid at the extremity.

Sp. *Schistocephalus dimorphus, Bothriocephalus solidus, Tænia gasterostei* ABILDGARD, *Skrivter of naturh. Selskabet* I. 1790, Tab. V. fig. 1, BREMSER,

*Icon. Helm.* Tab. XIII. f. 10, 11; LEUCKART, l. l. Tab. II. fig. 27, (in the abdominal cavity (not in, but on the outside of the intestinal canal) in *Gasterosteus*. In water-fowls this worm changes its form and is then named *Bothrioceph. nodosus:* [its joints and genital organs become gradually developed in the intestinal canal of its new host, which had swallowed and digested the *gasterosteus*. See VON SIEBOLD, *Band u. Blasen-würmer*, s. 40.]

Sub-gen. *Triænophorus* RUD. Joints sub-indistinct; head bilabiate, armed on both sides with two tricuspid hooks (τρίαινα, *tridens*). See figures in LEUCK. l. l. Tab. II. f. 34—36, BREMSER *Icon. Helm.* Tab. XII. f. 4—16.

*Note.*—Genus *Scolex* MUELL. appears to be founded on imperfect species of *Bothriocephali*. The body is depressed, continuous as in *Ligula*. The head supplied with four fossettes. It is found in marine fishes, especially of the genus *Pleuronectes*.

*Tænia* L. (exclusive of many species). Body elongate, depressed, articulate. Head with four suctorial oscules, and mostly with a rostellum median, imperforate, retractile, armed most frequently with a coronet of hooklets, especially in the young state.

Sp. *Tænia solium* L. (in part), BREMSER, *Ueb. leb. Würm.* Tab. III. f. 1—14, GUER., *Iconogr., Zooph.* Pl. 12, f. 2, *Der Kurbiswürm, der Kettenwürm, Ver solitaire, le Tænia à longs anneaux.* It is a mistake, that in the same person only one worm of this species is invariably to be met with, as the French name *ver solitaire* indicates. This species lives in the small intestine, and is in Holland, Germany, and England, the ordinary and perhaps the only species of this family which occurs in the human body. Only very few cases are known where a person had both a *Tænia solium* and a *Bothriocephalus latus*[1]. These two tape-worms are distinguished not by the head alone, but also by the greater or less breadth of the body. In *Tænia solium* the middlemost joints are longer than they are broad; in *Bothriocephalus latus* the joints throughout the entire body have more breadth than length, and in the middle of each joint are two apertures of which the anterior is the larger and more readily perceptible; from it the *penis* occasionally hangs everted; in *Tænia solium* the apertures are at the edge of the joints and alternate irregularly, *i. e.* they are situated sometimes on the left, sometimes on the right side, without determinate order of succession (*foramina marginalia vagè alterna*). Since these worms are often rejected in fragments alone, the knowledge of these characters is for the Physician not without interest.

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[1] A case of this kind, the only one known to him, is given by RUDOLPHI *Grundriss der Physiol.* II. 2, s. 239, and another by W. VROLIK, *Bijdragen tot de natuurk. Wetensch.* III. 1828. *Boekbeschouwing*, bl. 292.

For the arrangement of the numerous species of this genus, RUDOLPHI availed himself also of the character of the hooklets on the head, and distinguished *inermes* and *armatæ*. But since this character is inconstant, and many of the *inermes* of RUDOLPHI have hooklets in the younger period of their life, it cannot be recommended for this purpose. Among the species occurring in our domestic animals *Tænia plicata* RUD., *Tænia magna* ABILDG., *Zool. dan.* Tab. 110, fig. 1, BREMSER, *Icon. Helm.* Tab. XV. fig. 1, deserves to be recorded for the great size of its tetragonal head, which surpasses that of all other species. It lives in the small intestine of the horse.

*Dithrydium* RUD. Uncertain genus. Comp. RUDOLPHI *Entozoor. Synops.* p. 559, VALENCIENNES *Ann. des Sc. nat.* 3e Série, II. *Zool.* 1844, p. 248. [VON SIEBOLD, *ibid.* Vol. XV. p. 201, says it is a larval form of a *Tænia* without joints and sexual organs.]

[RUDOLPHI'S first family of *Entozoa* is not included in the systematic arrangement of the Class in this edition of the Handbook, because it has been satisfactorily proved by VON SIEBOLD, VAN BENEDEN, DUJARDIN, BLANCHARD, &c., that it consists of larval forms of *Tæniæ*, usually encysted in situations unfitted for their further development, and in which they become distended with fluid. But from the great interest that attaches to them on account of their occurrence in the human body as well as in that of other vertebrates, we subjoin the description of them, with a reference to the literature contained in the 2nd Edit. of VAN DER HOEVEN'S *Handbook*.]

*Cystica*. Body depressed or roundish, terminating posteriorly in a vesicle full of fluid and proper to individual entozoa, or common to several. Sexual and digestive organs none. Head furnished with a coronet of hooklets and four suctorial oscules.

Comp. on cystic worms, AD. TSCHUDI, *Die Blasen-würmer. Ein monographischer Versuch.* Freiburg im Breisgau, 1837, 4to. mit 2 Kupfert.

*Echinococcus* RUD. Vesicle either single or enclosed in an external capsule formed by the organ in which it is contained. On the interior surface are set many entozoa, extremely minute, resembling a grain of sand, with body obovate.

Worms in this state have been ordinarily named *Hydatids*, a name which has also been extended to the rest of the cystic worms indiscriminately, as well as to serous vesicles, the consequence of a morbid nutrition, that contain no intestinal worms. LAENNEC

named these pathological products and *Echinococcus* also *Acéphalocystes.*

True *echinococci* propagate themselves by means of cells or vesicles within the parent vesicle. This last consists of several concentric, thin, albuminous layers; see VON SIEBOLD'S figure in VOGEL *Icon. Histologiæ pathologicæ*, Tab. XII. fig. 11. Frequently the worms die in the living body and the vesicles are changed into a gelatinous, yellow-green mass.

Comp. RENDTORFF *de Hydatidibus in corpore humano, præsertim in cerebro repertis*, Berolini, 1822, 8vo.; KUHN *Recherches sur les Acéphalocystes, Mém. de la Soc. d'Hist. nat. de Strasbourg*, I. 2, (1833); also transferred to the *Ann. des Sc. nat.* Tom. XXIX. pp. 273—300. (The Author distinguishes *Acephalocystis endogena* and *A. exogena*; some *Echinococci* appeared to multiply themselves by forming new vesicles on the outside of the parent vesicles; such vesicles, he says, occur, especially in the sheep, in the lungs and liver; VON SIEBOLD has not remarked this mode of propagation; WIEGM. and ERICHSON'S *Archiv f. Naturgesch.* 1845, 2 Bd. s. 241.) GLUGE *Note sur la structure microscopique des Hydatides, Bullet. de l'Acad. royale de Bruxelles*, 4 Nov. 1838, *Ann. des Sc. nat.* 2e Série, Tom. VIII. *Zool.* pp. 314—317.

Sp. *Echinococcus erraticus* mihi, *Echinococcus veterinorum* RUD., *Hist. nat. Entoz.* Tab. XI. fig. 4, BREMSER, *Icon. Helminth.* TAB. XVIII. figs. 3—13; in many domestic animals, especially in their liver. The *Echinococcus hominis* RUD., is probably not a different species from this. It has been met with in the abdominal cavity, in the liver, in the heart, also in the voluntary muscles, and in the cavities of the brain (*ventriculi cerebri*).

*Cœnurus* RUD. Vesicle single, on which are seated several worms, retractile, depressed, rugose.

Sp. *Cœnurus cerebralis* RUD., *Hist. nat. Entozoor.* Tab. XI. fig. 3, BREMSER, *Icon. Helminth.* Tab. XVIII. figs. 1, 2. There is only one species known, which occurs in the brain and spinal cord of sheep, occasionally also in cattle, in a species of antelope, and according to ROUSSEAU in rabbits. The *Vertigo of sheep* (*le tournis, das Drehen*) is a consequence of these worms; the symptoms vary according to the situation occupied by the worms; the general characters of the disease are, that the sheep at first are somnolent, then fall into convulsions, run up and down and die of exhaustion. The vesicles, filled with water, by their expansion compress the brain and distend the ventricles, and this sometimes to such an extent, that the bones of the skull are affected and become extremely thin.

*Cysticercus* RUD. Worm solitary with depressed and roundish body passing into a caudal vesicle. Another vesicle external, including the worm.

Sp. *Cysticercus cellulosæ* RUD., *Hydatis finna* BLUMENB. *Abb. naturhist. Gegenstände*, Tab. 39 (copied in GUÉR. *Iconogr. Zooph.* Pl. 13, fig. 5),

BREMSER *Ueb. leb. Würm.* Tab. IV. figs. 18—26. In man, in oxen, and especially in domesticated swine, in which this worm sometimes occurs in great numbers, and even in the heart and eyes (SŒMMERRING found this species once in the anterior chamber of the eye in man: since then it has been met with a few times in the *conjunctiva*); mostly in the muscles of voluntary motion, sometimes in the brain[1].

*Cysticercus fasciolaris* RUD. *Entoz. Hist. nat.* Tab. XI. fig. 1, BREMSER *Icon.* Tab. XVII. figs. 3—9; this species lives in the liver of rodents, especially of mice and rats. The jointed body is very long and the vesicle at its extremity small, so that the entire worm has the appearance of a Tænia. It has been surmised, that the *Tænia crassicollis* of cats proceeds from the *cysticercus fasciolaris* of rats.

*Note.*—The body which SULZER described as an *Entozoon* and named *Ditrachyceras rude* (*Diceras* RUDOLPHI), previously placed amongst the *cystica* and then amongst the *anthocephala*, is nothing else than a carpel of *Morus nigra*, macerated and deprived of its colour by the action of digestion.

*Tetrarhynchus* RUD. (*Gymnorhynchus* ejusd.; *Anthocephalus* ejusd.; *Floriceps* CUV.; *Rhyncobothrius* BLAINV., DUJARD.) Head bilobed, emitting four uncinate proboscides.

*a*) With body articulate. (Species of *Bothriocephalus* RUD., *Rhyncobothrius* DUJARD.

Sp. *Tetrarhynchus paleaceus, Bothrioc. tubiceps* LEUCK. op. cit. Tab. I. fig. 1; *Tetrarh. bicolor, Bothrioc. bicolor* NORDM. *Microgr. Beitr.* I. Tab. VII. figs. 6—10, &c.

*b*) With body continuous, elongate (*Gymnorhynchus* RUD.)

Sp. *Tetrarhynchus reptans, Scolex gigas* CUV., BREMS. *Icon. Helm.* Tab. XI. figs. 10—13, Tab. XVII. figs. 1, 2,

*c*) With body short, clavate, supplied with two bipartite *bothria* (*Tetrarhynchus* RUD.)

Sp. *Tetrarhynchus megacephalus* RUD. *Entozoor. Syn.* Tab. II. figs. 7, 8; *Tetrarh. discophorus* BREMS. *Icon. Helminth.* Tab. XI. figs. 14, 15, &c.

*d*) With body terminated posteriorly by a bladder, and included in a cyst (*Anthocephalus* RUD., *Floriceps* CUV.)

Sp. *Anthoceph. elongatus* CUV. *R. Ani.* (édit. I.) Pl. XV. figs. 1, 2, RUD. *Entozoor. Syn.* TAB. III. figs. 12—17, *Bothrioceph. patulus* LEUCK. l. l. Tab. II. figs. 29, 30. Lives in the mesentery of *Agathoriscus mola.*

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[1] Comp. I. C. STEINBUCH, *De Tænia hydatigena anomala.* Erlangæ, 1801, 8.

[*Note.*—The different species of *Tetrarhynchus* are, according to V. SIEBOLD, nothing else than imperfect and sexless forms of tape-worms, which in the perfect and developed condition belong to the genus *Rhyncobothrius* of RUDOLPHI. These last are found only in the intestinal canal of Rays and Sharks. The embryos of *Rhyncobothrii* make use of the bodies of other marine animals on which Rays and Sharks feed, as a temporary residence, until they attain to the intestinal canal of the latter by being swallowed together with their host. Such animals are Flat-fish, the Turbot, Barbel, Haddock, Gurnard, Conger-eel, Sepia; in all of which young *Tetrarhynchi* have been found. That in such situations they find only a temporary abode is proved by their being so frequently encysted, and by their restless state, for they perforate the flesh, the walls of the stomach, and the substance of the different organs, digging and boring with their four proboscides that can be forced in and out, and are covered with innumerable recurved hooklets. VON SIEBOLD *Band und Blasen-würmer*, pp. 43, 44.]

Family II. *Acanthocephala.* Body utricular, roundish, marked with transverse rugæ. Mouth none; proboscis retractile, covered with recurved hooks. Sexes distinct.

*Echinorhynchus* MUELL., RUD.

*Spiny-snouted worm.* This genus (the only one of the family and of which the characters, therefore, coincide with those of the family) abounds in species which occur especially in the intestinal canal of vertebrate animals (mostly of birds and fishes).

The largest species lives in the small intestine of the wild and tame hog, *Echinorh. gigas* CLOQUET *Anat. des vers intestinaux*, Pl. 5—8, BREMSER *Icon. Helm.* Tab. VI. figs. 1—4. See for the anatomy CLOQUET'S work; comp. BUROW *Echinorhynchi strumosi Anatome. Diss. Zootom.* Regiomonti, 1836, 8vo. This *Echinorh. strumosus* lives in the small intestine of different species of *Phoca*.

Family III. *Trematoda.* Body depressed or roundish, soft. Suctorial pores. Mouth distinct; nutrient canal divided, mostly ramose. All the individuals hermaphrodite.

*Distoma* RETZ., ZED. (*Fasciola* L. in part). Body soft, depressed or roundish. Two suctorial acetabula; one terminal anterior, with perforated base leading to the mouth, the other ventral, situated not far from the former, impervious.

Sp. *Distoma hepaticum*, and *Distoma lanceolatum* MEHL. *Fasciola hepatica* L., BREMSER *Ueb. leb. Würmer*, Tab. IV. figs. 11—14, MEHLIS *Observat. anat. de Distomate hepatico et lanceolato*, Gottingæ, 1825, fol.; the *liver-worm, fluke, la douve, Leberwurm, Schaafwurm*, occurs in the gall-bladder of man, but more frequently in ruminating animals, the ox, the deer, and especially the sheep. (MEHLIS has shewn that here two species have been confounded; the worm figured by BREMSER, op. cit., is *Distoma lanceolatum*.)

*Dist. globiporum* RUD. in different species of the genus *Cyprinus*. Comp. H. BURMEISTER in WIEGMANN'S *Archiv.* 1835, II. s. 187; V. SIEBOLD, *ibid.* 1836, I. s. 217—233, Tab. VI.; *Dist. appendiculatum* RUD. *Entoz. Hist. nat.* Tab. V. f. 1, 2; MAYER *Beiträge zur Anat. der Entoz.* 1841, pp. 18, 19; in the intestines of *Clupea alosa*, &c.

*Distoma Beroës* WILL, in ERICHSON'S *Archiv.* 1844, s. 343—345, Taf. 10, figs. 10—13.

*Diplostomum* NORDM. Body soft, depressed, oval or roundish, elongate. Mouth anterior, elliptic; suctorial acetabula two ventral, the anterior the smaller, situated nearly in the middle of the body. (Small animals living gregariously in the eye of fishes.)

Sp. *Diplost. volvens* NORDM. *Mikrogr. Beitr.* I. Tab. II.; found by NORDMANN in the vitreous humour and in the lens of different fresh-water fishes (*Perca fluviatilis, Gadus lota*, &c.) It may be the cause of a species of Cataract; see the figures at Tab. I. figs. 1, 2.

*Note.*—Genus *Cercaria* MUELL. (comp. above, p. 171,) contains larvæ of *Distomata*. Similar larvæ of *Trematoda* have caused the formation of other genera by authors. Here are to be referred *Bucephalus* V. BAER, and *Leucochloridium* CAR.

*Amphistoma* RUD. (*Strigea* ABILDG.) Body soft, roundish. Single anterior and posterior pore.

Comp. C. M. DIESING *Monographie der Gattungen Amphistoma und Diplodiscus, Ann. des Wiener Museums*, I. 1836, pp. 235—260; also his *Nachtrag zur Monographie der Amphistomen, ibid.* II. 1839, s. 235—252.

Genera *Holostomum* NITZSCH, *Diplodiscus* DIES.

Sp. *Amph. cornutum* RUD. *Ent. Hist. nat.* Tab. V. figs. 1—7, (*Holostomum*), in the intestines of *Charadrius pluvialis;* most of the species of *Amphistoma*, particularly of the sub-genus *Holostomum*, live in birds; *Amph. subclavatum* (*Diplodiscus subclavatus* DIES.), BREMSER *Icon. Helm.* Tab. VIII. figs. 30, 31, DIESING *Wiener Ann.* I. Tab. XXIV. f. 19—24, is from the intestine of *Rana* and *Bufo; Amph. conicum* MUELL. *Naturforscher* XVIII. Tab. III. f. 11, DIESING l. l. Tab. XXIII. figs. 1—4, is from the paunch of the ox and other ruminating animals; comp. LAURER *De Amphistomate conico*, Gryphiæ, 1831.

*Monostoma* ZED., RUD. (*Festucaria* SCHRANK, CUV.) Body soft, roundish or depressed. Single anterior pore, aperture inferior or anterior.

Sp. *Monostoma faba* SCHMALZ *Tab. anatomiam entozoor. illustr.* 1831, Tab. VI., MIESCHER *Beschreib. und Untersuch. der Monostoma bijugum*, 1838, 4to. In some species of the genus *Fringilla* this *Entozoon* has been found occasionally in membraneous sacs immediately beneath the skin, usually of the abdomen, back, or even of the thighs, and resembling round elastic tumours of the size of a pea. In every sac lie two worms (of the length of 1½ or 2 lines, and of the same breadth) in a little fluid. *Monost. plicatum* CREPLIN, *Nov. Act. Acad. Cæs. Leop. Car.* XIV. 2, 1829, Tab. 52, in the *Bal. rostrata*, &c.

*Aspidogaster* V. BAER.

*Tristoma* CUV., RUD. (*Capsala* BOSC, *Phylline* OKEN, *Nitzschia* V. BAER). Body depressed. Mouth anterior between two acetabula simple, marginal; third acetabulum posterior, large, circular, and marked internally with projecting lines; these are disposed frequently in the form of a wheel or a star.

Comp. DIESING *Nov. Act. Acad. Leop. Car.* TOM. XVIII. 1, Tab. I. (and in French *Monographie du genre Tristoma, Ann. des Sc. nat.* 2e Série, IX. *Zool.* 1838, pp. 77—89, Pl. I.) These worms live on the gills or on the skin of different fishes, and thus are not *entozoa* in the proper sense of the term, but rather external parasites. Sp. *Tristoma coccineum* CUV. *R. Ani.* 1817, Pl. XV. fig. 3, RUDOLPHI *Entozoor. Synops.* Tab. I. figs. 7, 8, BREMSER *Icon. Helm.* Tab. X. figs. 12, 13, on the gills of *Orthagoriscus mola* and other fishes. *Trist. maculatum* RUD. *Voyage de* LA PEROUSE IV. pp. 79, 80, Pl. 50, figs. 4, 5, on a species of *Diodon* of *California.*—*Tristoma hamatum* RATHKE, *Hirudo hippoglossi* MUELL., BAST. *Natuurk. Uitsp.* II. Tab. VIII. fig. XI. p. 152, *Zool. danica*, Tab. 54, figs. 1—4 (*infra*), G. JOHNSTON *Ann. of Nat. Hist.* I. 1838, p. 431, Pl. XV. figs. 1—3, RATHKE *Nov. Act. Acad. Leop. Car.* XX. 1843, *Beiträge zur Fauna Norwegen's*, pp. 238—242, Tab. XII. figs. 9—11; on the Halibut, &c.

*Polystoma* RUD. Body roundish or depressed, narrowed forwards, with terminal mouth; in the posterior dilated portion furnished with six acetabula muscular, supported by horny parts, uncinate.

Genera *Hexacotyle* DE LA ROCHE, *Hexabothrium* NORDMANN.

Sp. *Polystoma integerrimum* RUD., BREMS. *Icon. Helminth.* Tab. X. figs. 25, 26; the urinary bladder of the frog, &c.

*Note.*—Genus *Diplobothrium* LEUCK. (Sp. *Diplobothr. armatum* in the gills of *Acipenser stellatus*) is said to differ from *Polystoma* by its six *anterior acetabula;* comp. LEUCKART *Zoologische Bruchstücke* III. Freiburg, 1842, 4to. pp. 13—18, Tab. I. fig. 6. NORDMANN considers these *acetabula* to be posterior, and does not separate the species from the *Polystomata*, but calls it *Hexacotyle elegans;* LA MARCK *Hist. nat. des ani. s. v.* 2e édit. III. 1840, p. 600.

*Octobothrium* LEUCK. (*Mazocraes* HERM., *Octostoma* KUHN). Body soft, elongate, depressed, furnished posteriorly on each side with four bivalve acetabula. Mouth anterior, simple. (Mostly two anterior acetabula lateral, small.)

Comp. HERMANN *Naturforscher* XVII. 1782, pp. 180—182, Tab. IV. figs. 13—15; LEUCKART *Breves animal. Descr.* Heidelb. 1828, p. 18, *Zool. Bruchstücke* III. 1842, pp. 18—33, KUHN *Description d'un nouveau genre de l'ordre des Douves, Mém. du Muséum* XVIII. 1829, pp. 357—362. Pl. 17 bis.

These species live on the gills of fishes. The most common is the species that lives on the shad (*Clupea alosa* L.): *Octobothrium lanceolatum* LEUCK., *Breves anim. Descr.* Tab. I, fig. 7 *a, b*, KUHN *Mém. du Mus.* l. l. figs. 1—3, MAYER *Beitr. zur Anat. der Entoz.* pp. 19—25, Tab. III. figs. 1.—x.

*Diplozoon* NORDM. Body cruciate, as though formed of two worms adhering together. Posteriorly four prehensile organs (suctorial acetabula) adhere to each limb on both sides, set upon a common disc.

Sp. *Diplozoon paradoxum* NORDM. *Mikrogr. Beit.* I. Tab. V. VI. (and *Ann. des Sc. nat.* Tom. XXX. Pl. 26). This singular animal was discovered by NORDMANN on the gills of the Bream (*Cyprinus brama*); it is 3—5 lines long, and presents a body as if two specimens of *Octobothrium* had grown together in the middle, like the Siamese twins. Other observers also have met with this animal on the gills of other species of the genus *Cyprinus*. DUJARDIN found very small *entozoa* on the gills which resembled a half *Diplozoon*, and formed thereof the genus *Diporpa;* he leaves it undetermined whether they are young and separate individuals of *Diplozoon*. [This question has been determined in the affirmative by V. SIEBOLD. He discovered in the middle of the posterior portion of the body two slender hooklets which had been overlooked by DUJARDIN in *Diporpa* and by NORDMANN in *Diplozoon:* they are bent back at an acute angle. *Diporpa* is without sex, and always much smaller than *Diplozoon;* it has, moreover, behind the middle of the body, at that part where the two bodies of *Diplozoon* coalesce, a sucker. The prehensile organs are much simpler in *Diporpa* than in *Diplozoon;* but SIEBOLD found instances of every intermediate stage of complexity in them in different pairs of *Diporpa* which had coalesced, so that in some the resemblance to *Diplozoon* was in all respects exact. After this conjugation or copulation, the generative organs appear in the united individuals, and eggs are produced. See C. TH. V. SIEBOLD *Ueber die Conjugation des Diplozoon paradoxum, nebst Bemerkungen ueber die Conjugations-Process der Protozoen.* In *Zeitsch. für Wissensch. Zoologie,* III. 1851, pp. 62—68.]

The motion of fluid which NORDMANN thought he perceived in the vessels and their branches (in each half of the animal there are on each side two principal stems) is according to later investigations to be ascribed to vibratile cilia which exist on the inner surface of these vessels and produce the appearance of a very rapid current. (EHRENBERG, WIEGMANN'S *Archiv.* 1835, II. s. 128, MAYER *Beitr. z. Anat. der Entoz.* s. 23, 24.

*Note.*—Doubtful genera: *Gyrodactylus* NORDM., *Mikrogr. Beitr.* I. p. 195, *Hectocotylus* CUV. *Ann. des Sc. nat.* Tom. XVIII. 1829, p. 147, Tab. XI. A, *Phœnicurus* RUD. (*Vertumnus* OTTO, *Nov. Act. Acad. Leop. Car.* XI. 2, p. 294, Tab. XLI. fig. 1). Comp. DUJARDIN *Hist. Nat. des Helminthes*, pp. 480—482, and 640.

## ORDER II. *Cœlelmintha* s. *Utricularia.*

Entozoa with nutrient canal suspended in a distinct abdominal cavity, supplied with mouth and anus. Sexes distinct.

Family IV. *Nematoïdea.* Body round, elastic, often attenuated, filiform.

Phalanx I. *Acanthotheca* DIESING. Mouth inferior between two pores on each side which emit a single or double hooklet. Body roundish or depressed, transversely annulate.

*Pentastoma* RUD., *Linguatula* FRŒLICH, LAM.

The worms of this genus were arranged by RUDOLPHI with the *Trematoda*, but they differ from these by their internal structure; in external form some species resemble the *Cestoïdea;* they form a small group which ought to be separated from the proper *Nematoïdea*, but still belongs to the *Cœlelmintha*. Comp. on this genus G. M. DIESING *Versuch einer Monographie der Gattung Pentastoma, Annalen des Wiener Museums* I. 1835, s. 1—32, Tab. I.—IV.

Sp. *Pentastoma tœnioïdes* RUD., *Linguatula tœnioïdes* LAM., CUV., OWEN, RUD. *Entozoor. Hist. nat.* Tab. XII. figs. 8—12, BREMSER *Icon. Helm.* Tab. X. figs. 14—16, DIESING l. l. Tab. III. figs. 1—5, OWEN *Trans. of Zool. Soc.* I. 4. 1835, pp. 325—330. Pl. 4, f. 10—16, MIRAM, *Beitrag zu einer Anatomie des Pent. tœnioïd. Nov. Act. Acad. Cæs. Leop. Car.* Tom. XVII. 1835, pp. 623—646, Tab. 46, *Ann. des Sc. nat.* 2e série, Tom. VI. 1836, *Zool.* p. 135, Pl. 8; in the frontal sinus of the dog and the wolf, also in the larynx of these animals, and, according to some observations, in the frontal sinuses of the horse and the ass; the male is four times smaller than the female, which attains a length of three inches and more.

*Pentastoma moniliforme* DIESING l. l. Tab. IV. figs. 11—13; in the lungs of the Indian serpent (Python).

The name *Pentastoma* is to be rejected, because the four lateral openings near the mouth are not mouths, and because by its resemblance to similar names of genera of *Trematoda* it may easily mislead to the idea of an union with this division. It is, however, so generally received, that it can scarcely be altered without needless confusion. The name *Linguatula* of FRŒLICH as the older would deserve the preference, but it applies properly

only to some species from Mammalia, which have a flat tongue-like form, and especially to that found in the lungs of the hare by FRŒLICH, and not since re-discovered, *Linguatula serrata*. See J. A. FRŒLICH, *Beschreibung einiger neuer Eingeweidewürmer, Naturforscher* XXIV. 1789. s. 148—150. Tab. IV. f. 14, 15.

[T. D. SCHUBERT (Letter to V. SIEBOLD *Zeitschr. f. wissenschaftl. zool.* IV. 1852. s. 117, 118) concludes from his observations on the development of *Pentastoma* in the egg that it ought to be placed amongst the *Acarina* or *Lernæacea*. The embryo has two hooklets at the anterior part, or head, two pairs of lateral appendages or feet, each foot furnished with two claws, and a tail as long as the rest of the body, into which the intestinal canal is continued.]

Phalanx II. *Strongyloïdea* nob. Mouth terminal, or sub-terminal anterior, not surrounded with retractile hooks. Body round, elongate, elastic.

a) Mouth anterior, not terminal.

*Rictularia* FRŒLICH, DUJARD.

Comp. FRŒLICH *Naturforscher* XXIX. 1802. s. 9. Tab. I. f. 1—3; DUJARDIN *Helminth.* p. 280.

*Ophiostoma* RUD.

Genera *Dochmius, Dacnites* DUJ.

b) Mouth anterior, terminal.

*Cucullanus* MUELL. Body elongate, posteriorly attenuated. Head broad, with bivalve apparatus for manducation. Mouth a longitudinal, vertical fissure.

Sp. *Cucullanus elegans* ZEDER, RUD., *Entoz. Hist. nat.* Tab. III. figs. 1—3; BREMSER *Icon. Helm.* Tab. II. figs. 10—14; in the intestinal canal, the stomach and the pyloric appendages of the perch and other fresh-water fishes; almost all the other species of this genus live likewise in the intestinal canal of fishes.

*Heterocheilus* DIESING.

*Strongylus* MUELL. Body round, sometimes filiform, very long, acuminated anteriorly. Mouth orbicular or triangular. Apex of the tail terminated in the male by a bursa emitting a double or single penis.

Sp. *Strongylus gigas* RUD. *Entozoor. Hist. nat.* Tab. II. figs. 1—4; BREMSER *Ueb. leb. Würm.* Tab. 3—5, in the kidneys of man and of different mammalia; this worm can attain the length of more than a foot, the female of three feet. The colour is red, as in many other species of this genus.

Genera *Pseudalius* DUJARD., *Sclerostoma* DUJ., *Stenurus* DUJARD.

Sp. *Strongyl. inflexus, Stenurus inflexus* DUJ.; found by W. VROLIK in large numbers in the pulmonary arteries and veins of the *Delphinus phocæna*. See *Bijdragen tot de natuurk. Wetensch.* I. 1826. bl. 77—84.

*Stephanurus* DIESING.

*Spiroptera* RUD. (and *Physaloptera* RUD.) Body attenuated anteriorly or at both ends. Mouth orbicular, sometimes surrounded by papillæ. Tail of male mostly rolled spirally or deflected, supplied with a lateral expansion or bladder inferior, not terminal; tail of female conical, straight.

Most of the species of this genus live in mammals and birds between the coats of the œsophagus or of the stomach. Sp. *Spiroptera strongylina* RUD., BREMSER *Icon. Helminth.* Tab. II. figs. 15—18, in the wild and tame hog;—*Spiropt. strumosa, Ascaris strumosa* FRŒLICH, *Naturforscher* XXV. Tab. III. fig. 15, C. L. NITZSCH *Spiropteræ strumos. Descriptio.* Halæ, 1829. 4to, cum Tabula; in the stomach of the mole, &c.

*Dispharagus* DUJ. (Species of *Spiroptera* RUD.) Head terminated by two papillæ surrounding the mouth.

Sp. *Spiropt. cystidicola* RUD., *Cystidicola* G. FISCHER, REIL'S *Archiv.* III. 1799. s. 95—100. Tab. II.; in the swim-bladder of trout.

*Odontobius* ROUSSEL DE VAUZÈME. (Is this its place?)

*Ascaris* L. (in part), RUD. (*Ascaris* and *Heterakis* DUJ.) Body acuminate at each extremity. Head trivalved. Male genital organ a double spiculum.

Most of the species live in the intestinal canal of vertebrate animals. Sp. *Ascaris lumbricoïdes* L., A. VALISNIERI *Opere fisico-mediche*, Venezia, 1733, I. pp. 271—282. Tab. 34, 35, BREMSER *Ueb. leb. Würmer*, Tab. I. figs. 13—17, *Icon. Helm.* Tab. IV. figs. 10, 11; *round worm, le lombric, der Spul-wurm*, &c. This species lives in the intestinal canal of man, and attains the length of 15 inches; with this is usually united a similar worm from the horse, which, however, according to CLOQUET and GURLT, differs from it (*Ascaris megalocephala*). Also the round-worm which occurs in the swine, is, according to DUJARDIN, specifically different (*Ascaris suilla* DUJ.) Comp. on the structure of the round-worm the work of CLOQUET indicated above.

*Oxyuris* RUD., BREMS. Body cylindrical or fusiform, the posterior part in the female attenuate, subulate. Mouth orbicular or triangular. Penis vaginate simple, with a small posterior accessory part. (Small worms, the females much bigger than the males.)

Sp. *Oxyuris vermicularis, Ascaris vermicularis* L., BREMSER *Ueb. leb. Würm.* Tab. I. figs. 6—12; *Der Mastwurm, Springwurm;* it lives in the large intestine of man (especially in children), and causes a very troublesome itching and occasionally various nervous symptoms. The male was first discovered by BREMSER in 1815, in a specimen sent to him by SŒMMERRING, (see S. TH. V. SŒMMERRING'S *Leben u. Verkehr mit seinen Zeitgenossen* von R. WAGNER. Leipsig, 1844. I. s. 340) previously the much larger female alone was known.

*Tricocephalus* GOEZE. Body filiform, elongate anteriorly capillary, passing suddenly into the more ample posterior part. Male genital organ a simple spiculum, long, vaginate.

Sp. *Tricocephalus dispar* RUD., BREMSER *Ueb. leb. Würmer.* Tab. I. figs. 1—5; this species has frequently been met with in the intestinal canal of man, especially in the *cæcum*, first by MORGAGNI, afterwards by RŒDERER, &c., in bodies of persons dying of typhus (ROKITANSKY *Handb. d. path. Anat.*); frequently in cholera-subjects in Italy by DELLE CHIAJE (*Isis*, 1843, p. 557).

*Trichosoma* RUD.

Comp. RUD. *Entozoor. Synops.* p. 13, DUJARDIN *Ann. des Sc. nat.* 2e Série, XX. 1843, *Zoologie*, p. 332, pl. 14.

Genera: *Thominx, Eucoleus, Calodium* DUJARD.

*Filaria* MUELL. Body very long, filiform, subequal. Mouth orbicular. Male genital organ a long spiculum with a contorted accessory part.

Sp. *Filaria medinensis, Gordius medinensis* L., BREMSER *Ueb. leb. Würm.* Tab. IV. fig. 1. *Dracunculus, Vena medinensis*, the *hair-worm, guinea-worm, le dragonneau*, &c. This worm lives in man under the skin in the cellular tissue, especially in the legs, and may attain a length of ten feet; male individuals of this species do not seem to have been observed hitherto. Sometimes this worm occasions severe pain; it is met with in hot countries especially of the old world, less frequently in America, except in the island of Curaçao, where it is endemic, although the worm-sickness does not always prevail there with the same intensity. See the still interesting notices of B. HUSSEM in the *Vehr. van het' Zeeuwsch. Genootsch.* II. 1771, 443—464. The thread-worm is viviparous, and the young differ in form from the mother. See JACOBSON and DE BLAINVILLE in *Ann. du Muséum, nouvelle Série* III. pp. 80—85.

*Liorhynchus* RUD. Body round. Head without valve, with tubule of mouth emissile, smooth. (Doubtful genus.)

Sp. *Liorhynchus denticulatus* RUD., BREMS. *Icon. Helm.* Tab. V. figs. 19—22; in the stomach of *Muræna anguilla.*

*Cheiracanthus* DIES. Body annulate, posteriorly attenuate, anteriorly armed with palmate or dentate spinules, which in the middle

of the body are simple, in the posterior part evanescent. Head subglobose, beset with simple spinules. Mouth bivalved naked. Tail of male spiral, with genital spiculum elongate, simple.

Sp. *Cheiracanth. robustus* DIES. *Ann. des Wien. Mus.* II. 1840, Tab. XV. figs. 1—7; in the stomach of different species of Cat. This animal has four long sacs near the œsophagus which recal the *lemnisci* of the *Acanthocephala*. According to DIESING the genus *Gnathostoma* OWEN, (*Proceedings of the Zool. Society* IV. 1836, pp. 123—126), a worm found in the walls of the stomach of a tiger, is not distinguishable from this; the mouth however is differently described by OWEN.

*Lecanocephalus* DIESING. Body anteriorly obtuse, with head expanded in form of a platter, and mouth trilabiate. Simple spines surrounding the body in zones. Tail of male inflected, with double spiculum.

Sp. *Lecanoc. spinulosus* DIESING, *Ann. des Wien. Mus.* II. Tab. XIV. figs. 12—20.

*Ancyracanthus* DIESING. Body acuminate at both ends. Mouth orbicular, armed with four spinules pinnatifid, disposed in a cross. Tail of male inflected, with double spiculum.

Sp. *Ancyr. pinnatifidus* DIESING, *Ann. des Wien. Mus.* II. Tab. IV. figs. 21—27; in the stomach and small intestine of South American tortoise. Here also there are four long cæcal sacs near the œsophagus, as in *Cheiracanthus*.

*Note.*—To the *Nematoïdea* are also referred some filiform *entozoa*, included in a vesicle. In the peritoneum of various fishes, between the coats of the intestines and elsewhere a white worm of this sort, convoluted spirally, is found, which LINNÆUS called *Gordius marinus*, RUDOLPHI *Filaria piscium*. Comp. SIEBOLD in WIEGM. *Archiv.* IV. 1838, pp. 305, &c. Here also belongs a microscopic worm found by OWEN in the muscles of man, and called *Trichina spiralis*. See *Transact. of the Zool. Soc.* I. 4to. 1835, pp. 315—324, Tab. 41, figs. 1—9. Is it a *Nematoïd* in an imperfect state, the rest of whose fortunes are unknown? [This is V. SIEBOLD'S opinion. The encysted *Trichina* is sexless and does not increase in size. Sometimes the liver of different marine fishes is beset with cysts containing round worms which have grown to an inch or more in length; they have been named *Ascaris capsularis*, *Filaria piscium*, &c. SIEBOLD could never discover in them sexual organs, but still they have so remarkable a resemblance to *Ascaris osculata*, *spiculigera*, *angulata*, &c., worms with developed sexual organs which live in the intestinal canal of the Seal, the Cormorant, the Diver, the Gull, and predaceous fishes, that they may be suspected to be related to them. SIEBOLD believes that the encysted sexless worms only attain their perfect development in the intestine of the vertebrates which have swallowed their temporary hosts. VON SIEBOLD *Band u. Blasen-würm.* S. 32, 33.

# APPENDIX

## TO THE CLASS OF INTESTINAL WORMS.

THERE are certain worms which do not live in other animals, but reside in water, or in moist earth, or in vegetable substances undergoing acetous fermentation, and which, nevertheless, since in form and internal structure they correspond with *Ascaris*, *Oxyuris*, or *Filaria*, appear to belong to the order of thread-worms. Some of them were by former writers arranged amongst the Infusories, as species of the genus *Vibrio*. To these belong the minute animals which LINNÆUS brought together under the name of *Chaos redivivum*, and which were described and figured by MUELLER as varieties of one species, *Vibrio anguillula* (*Animalcula infusoria*, pp. 63–68), although he doubted whether they ought not to be regarded as different species of a genus for which he had altready proposed the name *Anguillula*, by naming them *Anguillula aceti*, *Ang. glutinis*, *Ang. fluviatilis*, and *Ang. marina*. The genus *Anguillula* was afterwards adopted by EHRENBERG to distinguish these animals from *Vibrio*[1]. DUJARDIN named the same genus *Rhabditis*, but assigned to it somewhat different characters.

*Anguillula* EHRENB. (*Rhabditis* DUJ.) Body filiform, pellucid. Mouth round, terminal, naked. Anus before the posterior extremity, sub-terminal. The male with tail naked or amplified by a membrane (alate). External genital organ a double spiculum. Tail of the female conical, acute.

Sp. *Anguillula aceti* GŒTZE *Naturforscher* XVIII. Tab. III. figs. 12—18; DUGÈS *Ann. des Sc. nat.* IX. 1826, Pl. 47, fig. 2; from 1—2 millim. in size; these animals may be frozen without dying, whilst occasionally on the other hand a slightly increased temperature affects them mortally. Another species, *Anguillula glutinis*, lives in sour paste (MUELL. *Infus.* Tab. IX.

[1] *Symbolæ physicæ*, *Phytozoa*, and *Organisation, systematik und geographisches Verhältniss der Infusionsthierchen*, Berlin, 1830, s. 68, 105. OKEN in his *Lehrb. der Naturgesch.* III. 1, 1815, s. 191, places these animals under the genus *Gordius*, yet in the index he keeps *Anguillula* as the name of a genus, (see s. 847).

figs. 1—4); this is killed by vinegar. A third species that lives in the grains of blighted ears of corn may be revived, after lying dry for months and years, by moistening, (NEEDHAM and BAUER).

Comp. on these species GŒZE *Naturforscher* I. 1774, s. 1—53, IX. 1776, s. 177—182, XVIII. 1782, s. 36—65, BAUER *Philos. Trans.* 1823, p. 1, Pl. 1, 2, (*Ann. des Sc. nat.* Tom. II. 1824, pp. 154—167, Pl. 7, 8), DUGÈS *Ann. des Sc. nat.* Tom. IX. 1826, pp. 225—251, Pl. 47, 48.

Also in the intestinal canal of insects minute worms have been observed and commonly considered to be *Ascarides*, which belong to this division[1].

In other species the mouth is provided internally with three unciform structures or jaws. They may be included in the genus *Enoplus* DUJARD. (*Enoplus*, *Oncholaimus* DUJARD., *Amblyura* EHRENB.?) They live in fresh and salt water.

Finally, certain small worms that live in water and in moist earth cannot well be placed otherwise than in the neighbourhood of the *Nematoïdea*; they are included in the genus *Gordius* L. (the *Filariæ* excepted). They are, however, distinguished from the Nematoïds by their structure, and especially by the absence of a posterior aperture in the intestinal canal. DUJARDIN and V. SIEBOLD have shewn that these animals in the early period of their life live parasitically in insects.

Family *Gordiacea*. Body filiform, extremely slender, elastic. Anus none; sexes distinct.

*Gordius* L. (in part). Head rotund, mouth none, or not distinct. Tail of male bifid, of female rounded.

Sp. *Gordius aquaticus* L., *Encyclop. Vers.* Pl. 29, fig. 1. Seven to ten inches long, scarcely half a line thick; comp. CHARVET *Nouv. Ann. du Mus.* III. 1834, pp. 37—46; BERTHOLD *Ueb. den Bau des Wasserkalbes*, Göttingen, 1842, 4to; V. SIEBOLD *Entomol. Zeitung*, 1843, s. 77, ERICHSON'S *Archiv.* 1843, II. s. 302—308.

*Mermis* DUJARD. Mouth terminal. In female the vulva forward, transverse.

Comp. *Ann. des Sc. nat.* 2e Série, Tom. XVIII. 1842, pp. 129, &c., Pl. 6.

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[1] Here, too, may be placed *Oxyuris grylli-talpæ*, LÉON DUFOUR *Ann. des Sc. nat.* 2e Série, Tom. VIII. *Zool.* Pl. 1. fig. 2, and perhaps the genus *Anguillina* of HAMMERSCHMIDT not described in detail (*Anguillina monilis* in *Aphodius conspurcatus*), OKEN'S *Isis*, 1838, p. 318, which however more probably belongs to *Mermis* DUJARDIN.

## CLASS VI.

### WHEEL-ANIMALCULES (*ROTATORIA*)[1].

We return from the consideration of different animals whose bodies amongst the Invertebrates may be styled large to that world, invisible to the naked eye, with which in the class of the Infusories we began to treat of the animal kingdom. And in the classes that follow, however some species may be found that are scarcely perceptible to the unassisted eye, no one of them consists entirely of creatures so small as Infusories and Wheel-animalcules. Wheel-animalcules, as a whole, surpass Infusories in size; still they are very minute animal forms, mostly between $\frac{1}{2}$—$\frac{1}{15}$ millimeter. Leeuwenhoeck, who discovered the Infusories, was also the first who observed some species of Wheel-animalcules.

The name of Wheel-animalcules is borrowed from the vibratile cilia which at the anterior extremity of the body are set upon the margin of a disc capable of eversion and inversion. In species, where that margin is not divided or indented, an optical illusion is caused by the motion of the cilia, as though a toothed wheel were revolving with great velocity in a circle, and so Leeuwenhoeck thought such was really the case, who compared the rotatory organ with the wheel of a watch-work[2]. Every one who has observed the phenomenon of vibrating cilia is aware that the deceptive appearance of a rapid motion or current in a given direction is produced: if, then, vibrating cilia be met with on the smooth margin of a circular structure, the appearance of a rotating wheel will follow of course. It is to be remarked, however, that the motion is

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[1] See on this class the works referred to (p. 37) at the class of *Infusoria* of Mueller, Ehrenberg and Dujardin. Also may be compared O. Schmidt *Versuch einer Darstellung der Organisation der Räderthierchen*, in Erichson's *Archiv f. Naturgeschichte*, 1846, s. 67—81, Taf. III.

[2] *Send-brieven*, 1718, VII. Brief. bl. 67. Dutrochet has attempted to explain the phenomenon by muscular motion; according to him the wheel is merely a circular, muscular string, which by its contraction causes other parts of the gelatinous substance to project alternately in the form of conical papillæ, whence a circular motion appears to arise. *Ann. du Muséum*, XX. 1813, pp. 469—473.

subjected to the will of the animal, for otherwise the vibratile cilia would be in a constant motion, which ceases only on death.

The Wheel-animalcules are capable of contraction in a remarkable manner, many of them assuming thereby an oval form. This faculty of contraction gave occasion to the name *Systolides*, by which DUJARDIN wishes to distinguish this class of animals, but which probably will not supersede that of *Rotatoria*. In some the integument is hard and rigid, so as to form a shield or a shell (*Brachionus*, *Anuræa*, &c.). In most there is a caudiform appendage on the abdominal surface (EHRENBERG names it *processus pediformis* or *pseudopodium*), which can be drawn in and out annularly like a telescope, and ends in a suctorial disc or in a forceps; by it the Rotatories fix the posterior extremity of the body, whenever, being at rest, they set the wheel-organ in motion.

The intestinal canal is straight, in by far the greatest number of species, and the *anus* is found at the hinder end, at the base of the tail. At the commencement of the intestinal canal, behind the oral aperture, is a muscular organ of cylindrical form armed with two lateral horny jaws. LEEUWENHOECK, BAKER and FONTANA took this structure for a heart, and its motions of grasping and opening, as the first of these authors so aptly describes them[1], for the contraction and expansion of the heart; whereon FONTANA expresses his surprise that such motions should be dependent upon the will of the animal. The lateral jaws indicate a similarity of form with articulate animals, the insects and crustaceans, and some writers have even supposed that the Wheel-animalcules may be regarded as very simply organised crustaceans[2]. On the whole, by inserting these animals between the intestinal and the articulate worms, the nearest affinities and natural place of the class are not indicated; but in an arrangement that gives the classes in succession, there must always be much that is arbitrary, for the affinities cannot be represented by a single ascending series.

The lateral jaws present themselves under two forms. In the greater number they consist of two pieces; the posterior serves as a pedicle, for the attachment of the muscles of mastication; the anterior passes transversely inwards at a right or obtuse angle, and

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[1] *Sevende vervolg der Brieven*, Delft, 1702, 144ste *Missive*, bl. 405.

[2] Such was the determination of NITZSCH in 1824 on the genus *Brachionus*.

ends in a single point, or in several teeth when the part becomes broad and indented in form of fingers. In other Rotatories the jaws have the form of two stirrups, with the bases turned towards each other, on which lie two or more teeth transversely, which arise from the outermost arch[1].

[Where the œsophagus opens into the stomach, or lower down, are two or more oval glandular pouches, which EHRENBERG compared to the *pancreas*. The stomach is large and sacculated, and in the saccules are large nucleated cells, or cœca are appended to them. The cells and cœca are supposed to supply the office of a liver. The intestine narrower, and of variable length, but generally short, opens into a cloaca, of which the outlet is on the dorsal surface at the extremity of the body. But sometimes the intestine and anal outlet are wanting, and then the residue of digestion is returned by the mouth[2]. The stomach and intestine are covered with fine vibratile cilia.

This description applies only to the females; for, in the year 1849, the very interesting discovery of the male of *Notommata anglica* was made by BRIGHTWELL[3] of Norwich, and in it the entire intestinal tract was absent; there were neither pharynx, jaws, œsophagus, nor digestive tube, and the mouth was closed.

There is no circulating system. The nutrient fluid fills the cavity of the body, and bathes all the contained organs. The respiratory organ is supposed to be represented by tortuous tubes, which are seen at each side of the body. A highly contractile transparent vesicle opens into the cloaca, and from this vesicle the tubes in question arise. To the tube on each side, minute pediculated structures, various in number, with vibratile leaflets, are attached.

The female organs consist of an ovary situated under the digestive tube, generally of an oval form, or like a horse-shoe, of which the efferent duct opens into the cloaca.

The ova are of two different kinds, summer- and winter-eggs, thin- or thick-shelled. The summer-eggs are developed within the parent body, and the animal is then viviparous. The winter-eggs have been described by EHRENBERG, by HUXLEY, and by LEYDIG, in many different species: their thicker external covering is granular, or tuberculated, or beset with hairs. The winter-eggs are always laid, or are attached

[1] See EHRENBERG *Zur Erkenntniss der Organisation in der Richtung des kleinsten Raumes*, Berlin, 1832, s. 46—51, Tab. IV.

[2] [DALRYMPLE *Descript. of an Infusory Anim. allied to Notommata, Phil. Trans.* 1849, p. 333.]

[3] [*Annals of Nat. Hist.* Sept. 1848.]

to the mother and carried about by her (*Brachionus*, &c.); and thus, in the cold season of the year, these animals are oviparous.

Besides the male of *Notommata anglica*, discovered by BRIGHTWELL, that of *N. Sieboldii* has been observed by LEYDIG, who further gives reasons for believing that *Enteroplea hydatina* EHR. is the male of *Hydatina senta*, *Notommata granularis* the male of *Notom. Brachionus*, and *Diglena granularis* the male of *Dig. catellina*. GOSSE also has ascertained that the sexes are distinct in many others[1]. The males are less than the females, and also differ in form in most cases. The dioecious character of the class may thus be considered to be established.

The generative organs of the males consist of a white and round bladder or testis, filled with spermatozoa, and an efferent duct (*penis* DALRYMPLE) ciliated in the interior, which opens close to the outlet of the respiratory vesicle. All the males observed are entirely destitute of digestive tract; they possess the respiratory organs of their species, whose function seems to suffice for the maintenance of their short life, employed exclusively in impregnating the females.]

The nervous system has been discovered by EHRENBERG in different genera, and he described, as central portion, different ganglia (*ganglia cephalica seu cerebralia*), situated close to the wheel-organ, from which distinct nerves arise. In *Hydatina senta*, according to the investigations of the same observer, two threads also arise from them that run downwards on the abdominal surface, and unite to form a ganglion from which a single nervous string with many small ganglia or swellings arise[2]. As organs of sense, in most of them red eye-spots (generally two, sometimes one or three, seldom more than four) have been perceived; sometimes these exist in young individuals alone, and disappear on full growth, as in the genus *Floscularia*.

Besides the muscles of the special parts, there are found in many species thin bundles of muscles running longitudinally, one on the dorsal surface, one on the abdominal surface, and two lateral.

With respect to the geographic distribution of Wheel-animalcules nothing determinate can yet be specified. Only do we know, from the observations and notices of EHRENBERG, that, besides Europe, they are found in northern and western Asia, in the north of Africa and in North America. Beyond doubt they occur in all quarters of the world. The physiological peculiarity of life suspended for a length of time, to be again awakened by the vital stimulus of fluid, has given a special celebrity to these animals. On this subject we refer to what will be offered below when we notice *Rotifer vulgaris*, in which this phenomenon has been chiefly observed.

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[1] [GOSSE *On the dioecious charact. of the Rotifera, Proceedings of the Royal Soc.* Vol. VIII. pp. 66, 68.]

[2] *Die Infusionsthierchen*, s. 416. Somewhat differently ordered is the nervous system in *Notommata* (s. 425) and in *Diglena* (s. 443), but in all there lies a principal mass, as the collection of nervous ganglia, on the dorsal surface of the anterior extremity of the body.

# SYSTEMATIC

# ARRANGEMENT OF ROTATORIA.

## CLASS VI.

### ROTATORIA.

MICROSCOPIC animals, contractile, crowned with vibratile cilia at the anterior part of the body, which by their motion often resemble a wheel revolving rapidly. Intestine distinct; terminated at one extremity by a mouth, at the other by an anus; generation oviparous, sometimes (periodically) viviparous.

ORDER SINGLE. *Rotatoria.*

(The characters of the class are those of the single order.)

Family I. *Floscularicæ.* Tentacles or lobes around the mouth (with rotatory organ deeply cloven EHRENB.), furnished with cilia. Body affixed by a pedicle.

The hairs of this wheel-animalcule are, according to DUJARDIN, PELTIER and other observers, not vibratile cilia, but are capable individually of expansion and contraction; EHRENBERG, who admits that these hairs may for a long time continue at rest and be flaccid, still maintains that they occasionally vibrate, and refers to EICHHORN who perceived the same thing in his *crown-polyp, Stephanoceros* (*Beiträge zur Naturgesch. der kleinsten Wasserthiere*, s. 21).

*Floscularia* OKEN, EHRENB. Body clavate, or campanulate, anteriorly expanded, five or six lobes sustaining a fasciculus of long cilia. A vagina transparent, cylindrical, often covering the solitary animal.

Sp. *Floscularia ornata* EHRENB., *Der Fänger* EICHHORN I. l. Tab. III. figs. G—L, p. 39; EHRENB. *Organisation in der Richt. des kl. Raum. 3ter. Beitr.* Tab. VIII. fig. 2; *Infusionsth.* Tab. XLVI. f. 2; DUJARD. *Infusoir.* Pl. 19, figs. 7, &c.

*Stephanoceros* EHRENB. Body campanulate, surrounded by a transparent vagina. Tentacles five around the mouth, covered with cilia in whorls.

Sp. *Stephanoceros Eichhornii* EHRENB., *Der Kron-Polyp* EICHH. l. l. Tab. I. fig. 1; EHRENB. *Organis in d. Richt. d. kl. Raum. 3tter Beitrag*, Tab. XI. fig. 1, *Infusionsth.* Tab. XLV. fig. 2.

Family II. *Melicertina.* Rotatory organ simple, with margin entire or lobate. Two stapediform maxillæ, with teeth transversely incumbent. Body affixed by a pedicle.

*Ptygura* DUJARD. (*Ptygura*, *Œcistes*, *Conochirus* EHRENB.)

*Lacinularia* OKEN, SCHWEIGG. (*Megalotrocha* EHR. and *Lacilunaria* ejusd.) Rotatory organ large, incised on one side, hence bilobed or reniform. Animals often social, and sometimes covered by a gelatinous envelope.

Sp. *Lacinularia socialis* SCHWEIGG., *Hydra socialis* L., *Brachionus socialis* PALL., *Vorticella socialis* MUELL., *Infusor.* Tab. XLIII. figs. 13—15, (and *Vortic. flosculosa* MUELL. *ibid.* figs. 16—20), RŒSEL, *Ins.* III. Supp. Tab. 94, figs. 1—6; EHRENB. *Infusionsth.* Tab. XLIV. fig. 4. They form minute, white, conical bodies, which adhere to the roots of water-plants (*Lemna*, *Ceratophyllum*, *Chara*, &c.), and consist of fifty or more such wheel-animalcules, whose extremities are all directed to the centre. After a time the young ones separate themselves from this connexion, move away and adhere to different plants, to form new colonies. *Megalotrocha albo-flavicans* EHR., RŒSEL *Ins.* III. Suppl. Tab. 95, 96, (*Megalotr. alba* EHRENB., *Zur Erkenntniss d. Organis. in der Richtung des kleinsten Raumes. 2ter Beitrag*, Tab. III. f. 15, intestinal canal), EHR. *Infusionsth.* Tab. XLIV. fig. 3, is distinguished from the former species by the absence of an envelope, though united with it by former writers.

*Tubicolaria* LAM. (in part), EHRENB. Body clavate, with rotatory organ four-lobed, and respiratory tube double, included in a gelatinous vagina.

Sp. *Tubicolaria najas* EHRENB., *Rotifer albo-vestitus* DUTROCHET, *Ann. du Mus.* Vol. XIX. Pl. 18, figs. 9, 10; EHRENB. *Infusionsth.* Tab. XLV. fig. 1.

*Melicerta* SCHRANK, OKEN. Body clavate, with rotatory organ four-lobed, and double respiratory tube, retractile within a vagina conico-tubular, granulose, opaque. Two ocelli in the younger age.

Sp. *Melicerta ringens* SCHRANK, *Sabella ringens* L., *Syst. nat. éd.* XII. LEEUWENHOECK, *Phil. Transact.* 1704, Vol. XIV. p. 1784, figs. 3, 4; *Sendbrieven*, Delft, 1718, VII^e. *Brief*, bl. 63, &c.; SCHÆFFER *Die Blumenpolypen der süssen Wasser.* Mit 3 Kupfert. Regensburg, 1755, 4to; *Rotifer quadricir-*

*cularis* DUTROCHET *Ann. du Mus.* Vol. XIX. Pl. 18, figs. 1—8; EHRENB. *Infusionsth.* Tab. XLVI. fig. 3. These animalcules seated in a case that adheres to duck-weed, belong to the forms which were first discovered by LEEUWENHOECK.

*Limnias* SCHRANK, EHRENB. Body clavate, with rotatory organ bilobed, and respiratory tubule none, solitary, retractile into an opaque envelope. Ocelli two.

Sp. *Limnias ceratophylli*, EHRENB. *Infusionsth.* Tab. XLVI. fig. 4.

Family III. *Brachionœa.* Animals swimming freely, covered with a membraneous scute univalve or bivalve, furnished with rotatory organ double or multiple (*zygotrocha* or *polytrocha* EHRENB.)

*Pterodina* EHRENB. Shield orbicular or oblong. Rotatory organ double. Two ocelliform points. Tail cylindrical, transversely rugose, terminated by a suctorial disc which is often ciliated.

Sp. *Pterodina patina* EHRENB., *Brachionus patina* MUELL., *Infusor.* Tab. 48, figs. 6—10, EHRENB. *Infusionsth.* Tab. LXIV. figs. 4, &c.

*Brachionus* HILL, MUELL. (in part). Scute urceolar, open in front and behind, with anterior aperture or both denticulate. Rotatory organs two. Maxillæ digitate.

I. *Tail articulate, forked at the point.*

*a*) With ocelliform point above the maxillæ. (Genus *Brachionus* EHRENB.)

Sp. *Brachionus urceolaris* MUELL., *Infusor.* Tab. L. figs. 15—21. EHRENB. *Organis. in d. Richt. des kl. Raumes, 3ter Beitrag*, Tab. IX. fig. III., *Infusionsth.* Tab. LXIII. figs. 3, &c.

*b*) Without ocelliform point. (Genus *Noteus* EHRENB.)

Sp. *Noteus quadricornis* EHRENB., *Infusionsth.* Tab. LXII. fig. II.

II. *Tail none.* (Genus *Anurœa* EHRENB.)

Sp. *Brachionus squamula* MUELL., *Anurœa squamula* EHRENB., MUELL. *Infusor.* Tab. 47, figs. 4—7, &c.

*Lepadella* BORY (spec. of *Brachionus* MUELL.) Scute oval, convex above, flattish beneath, open at both ends. Rotatory organ divided into several lobes. Tail triarticulate, forked at the extremity. Maxillæ naked, terminated by a single point, or by two or three teeth.

Genera: *Lepadella, Metopidia, Stephanops*, and *Squamella* EHRENB.

Sp. *Lepadella* (*Stephanops* EHRENB.) *lamellaris, Brachionus lamellaris* MUELL., *Infus.* Tab. 47, figs. 8—11; EHRENB. *Infusionsth.* Tab. LIX. figs. 13, &c.

*Euchlanis* EHRENB. (spec. of *Cercaria* MUELL.)

Sp. *Euchl. luna, Cercaria luna* MUELL., *Furcocerca luna* LAM., MUELL. *Infusor.* Tab. XX. figs. 8, 9; EHRENB. *Infusionsth.* Tab. LXII. figs. 10, &c.

*Dinocharis* EHRENB.

*Salpina* EHRENB.

*Colurus* EHRENB.

*Monura* EHRENB.

*Rattulus* LAM. (*Mastigocerca* and *Monocerca* EHRENB.) Body oval, covered with a scute carinate, narrowed posteriorly. Rotatory organ divided into several lobes. Tail styliform, long, rigid. Ocelliform point single.

Sp. *Rattulus carinatus* LAM., *Trichoda rattus* MUELL., EICHHORN *Wasserthiere*, Tab. II. fig. 0, *die Wasserratte* MUELL., *Infusor.* Tab. XXIX. figs. 5—7. (EHRENBERG distinguishes here two species and two *genera: Mastigocerca carinata* MUELL. l. l. fig. 7, *Infusionsthier.* Tab. LVII. fig. 7, which has a shell, and *Monocerca rattus*, Tab. XLVIII. fig. 7, to which EICHHORN'S drawing and the first two figures of MUELLER l. l. belong, which wants the shell, whilst he however remarks, that both are very similar; DUJARDIN is of opinion that only one species should be adopted.)

*Rattulus* EHRENB. With two ocelliform points, and tail styliform, inflected. (Animal naked? Is this its place?)

Sp. *Rattulus lunaris, Trichoda lunaris* MUELL., *Infus.* Tab. XXIX. figs. 1—3, EHRENB. *Infusionsth.* Tab. LVI. fig. 1.

*Polyarthra* EHRENB.

*Triarthra* EHRENB.

Sp. *Triarthra longiseta* EHRENB., EICHHORN *Wasserthiere*, Tab. I. fig. 7, EHRENB., *Organisat. in d. Richt. des kl. Raumes, 3tter Beitrag*, Tab. VIII. fig. 1, *Infusionsth.* Tab. LV. figs. 7, &c.

Family IV. *Hydatinæa* (*Furcularina* DUJARD.) Animals swimming freely, naked, with integument contractile, flexible, often marked by parallel rugæ. Tail forked.

A. Rotatory organ single, continuous, not lobed at the margin. (*Ichthydina* EHRENB. in part).

*Ichthydium* EHRENB. (species of *Cercaria* MUELL.) Body smooth.

Sp. *Ichthyd. podura* EHRENB., *Infusionsth.* Tab. XLIII. fig. 2.

*Chætonotus* EHRENB. (species of *Trichoda* MUELL.) Body hairy.

Sp. *Chætonotus larus, Trichoda larus* MUELL., *Infusor.* Tab. 31, figs. 5—7; EHRENB. *Infusionsth.* Tab. XLIII. figs. 4, &c.

[DUJARDIN (*Infus.* p. 268, 1841) gave reasons for the exclusion of *Chætonotus* and *Ichthydium* from the *Rotatoria*, and placed them provisionally in his order *Infusoires symétriques*. Afterwards C. VOGT referred them to the *Turbellaria*. SCHULTZE discovered in the sea-sand at Cuxhaven (1853) a new genus and species closely allied in anatomical structure to our *Ichthydina*, which he named *Turbanella hyalina*. Neither in *Ichthydium* nor *Chætonotus* do the cilia form a true wheel-organ round the mouth capable of protrusion and retraction. In *Ichthydium* they are spread over the entire abdominal surface; in *Chætonotus* over the whole of the anterior half of the abdomen, and at the margin of the posterior half form a band which surrounds the closely set, stiff hairs, which are much finer than the spines on the dorsal surface and directed backwards to cover the non-ciliated portion of the abdomen. The tail is forked, but not jointed. The intestine is straight, the anal opening at the fork of the tail. Neither vessels, nerves, nor muscles can be seen, except that the œsophagus is muscular. The sexual organs are situated between the intestinal canal and the integument of the back, the testes consisting of a loose cluster of vesicles in front of the ovary. SCHULTZE concludes that the *Ichthydina* of EHRENBERG (exclusive of his genera *Ptygura* and *Glenophora* which are true rotatories) must be excluded from the *Rotatoria*, and that they belong more nearly to the *Turbellaria* than to any other order of worms. There are however remarkable differences of structure between them and any family of *Turbellaria*. For in those *Turbellaria* which have a straight intestine with anal opening, the sexes are distinct; whilst in those which are hermaphrodite the intestine has no anal opening. SCHULTZE contends however that in worms the characteristic derived from the form of the intestinal canal is of greater systematic value than that derived from the formation of the sexual organs: and recommends that the *Ichthydina*, limited as above, be placed provisionally amongst the *Microstoma* of the order *Turbellaria*, which will then require to be subdivided into the dicœcious and the monœcious (*Ichthydina*). See SCHULTZE in MUELLER'S *Archiv.* 1853. s. 241–253. Taf. VI.]

B. Rotatory organ multilobed or parted (*Hydatinæa* EHRENB.)

*Otoglena* EHRENB. Maxillæ none. Ocelliform points three, the middle one sessile, the two lateral pediculate.

*Enteroplea* EHRENB. Body oval, oblong, anteriorly truncate. Maxillæ none. Ocelliform points none.

Sp. *Entoroplea hydatina* EHRENB. Tab. XLVII. fig. 1, DUJARD. *Infusoires*, Pl. XIX. fig. 2.

*Hydatina* EHRENB. Body oval, anteriorly truncate. Maxillæ digitate at the extremity, terminated by teeth five in number, free. Ocelliform points none.

Sp. *Hydatina senta, Vorticella senta* MUELL., *Infusor.* Tab. XLI. figs. 8—14; EHRENB. *Organisation, Systematik,* &c. 1830, Tab. VIII. *Infusionsth.* XLVII. fig. 2; this is the animal in which EHRENBERG first demonstrated the composite structure of the *Rotatoria*.

*Notommata* EHRENB. (in part). Body oval or oblong, posteriorly narrower, anteriorly truncate. Maxillæ digitate, with several teeth at the extremity. Ocelliform point single, forward, dorsal, or several points clustered.

Sp. *Notommata clavulata* EHRENB., *Organisation in der Richtung d. kl. Raumes, 3ter Beitrag,* Tab. X. fig. 1, *Infusionsthierchen,* Tab. L. figs. 5, &c.

*Cycloglena lupus* EHRENB., *Infusionsth.* Tab. XVI. fig. 10, (the form of the maxillæ not yet accurately known).

*Synchæta* EHRENB. Body broad anteriorly. Rotatory organ armed with styles. Ocelliform point single, anterior, dorsal.

Sp. *Synchæta baltica* EHRENB., *Infusionsth.* Tab. LIII. fig. 5; phosphorescent, in the Baltic, &c.

*Furcularia* LAM. (in part), DUJARD. Maxillæ forcipate, with extremity usually undivided and acuminate, or bidentate, protractile as far as the margin of the rotatory organ.

*a*) Ocelliform point none. *Pleurotrocha* EHRENB.

Sp. *Pleurotrocha constricta* EHRENB., *Infusionsth.* Tab. XLVIII. figs. 1, &c.

*b*) Ocelliform point single. *Furcularia* and *Scaridium* EHRENB.

Sp. *Furcularia gibba* EHRENB., *Infusionsth.* Tab. XLVIII. figs. 3, &c.—*Furcul. longicauda* LAM., *Trichoda longicauda* MUELL., *Infusor.* Tab. XXXI. figs. 8—10, *Scaridium longicaudum* EHRENB., *Infusionsth.* Tab. LIV. fig. 1, with a hook in front on the wheel-organ and a very long tail, by which the animal progresses in the water by leaps.

*c*) Ocelliform points two (*Diglena* and *Distemma* EHRENB. exclusive of *Distemma marinum* ejusd.)

Sp. *Furcularia forcipata, Cercaria forcipata* and *vermicularis* MUELL., *Infusor.* Tab. XX. figs. 18—23; EHRENB. *Infusionsth.* Tab. LV. fig. 1, *Dekinia vermicularis,* MORREN *Bijdragen tot de natuurk. Wetensch.* V. pp. 227, &c.

*d*) Ocelliform points three (*Triophthalmus, Eosphora* EHRENB.)

*e*) Ocelliform points numerous, disposed in two clusters (*Theorus* EHRENB.)

*Lindia* DUJARD.?

*Note.*—Genus *Albertia* DUJARD. is distinguished by a shield in front of the rotatory organ and by a tail which is conical, short, undivided. Body cylindrical, elongate. It lives parasitically, in the intestinal tube of earth-worms and slugs. Comp. *Ann. des Sc. nat.* 2e série, Tom. x. p. 175, Tab. II.

Family V. *Philodinæa* EHRENB. (*Rotifera* DUJARD.) Animals swimming freely or creeping (after the manner of geometric caterpillars). Body elongate, fusiform, contractile into a ball. Rotatory organ double. Tail articulate, furnished posteriorly with little horns or styles. The stapediform maxillæ with two parallel teeth, sometimes with three.

*Rotifer* CUV.[1] (The characters of the family.)

*a*) Without proboscis.

*Typhlina* EHRENB. (and *Hydrias* ejusd. Ocelliform points none).

*Monolabis* EHRENB. Ocelliform points two.

*b*) Anterior process retractile, proboscidean.

*) Ocelliform points none.

*Calladina* EHRENB.

**) Ocelliform points two.

*Philodina.* The ocelliform points situated behind the proboscis.

Sp. *Philodina erythrophthalma* EHRENB., *Organisation, Systematik,* &c. Berlin, 1830, Tab. VII. fig. 2; *Infusionsth.* Tab. LXI. fig. 4; by former writers confounded with *Rotifer vulgaris.* DUJARDIN names this species, with which he thinks some other species of *Philodina* EHRENB. ought to be united, *Rotifer inflatus, Infusoires,* Pl. 17, fig. 2.

*Rotifer* EHRENB. (and *Actinurus* ejusd.). Ocelliform points situated at the anterior part of the proboscis.

Sp. *Rotifer vulgaris* SCHRANK, EHRENB., *Furcularia rediviva* LAM., *Vorticella rotatoria* MUELL., *Infusor.* Tab. XLII. figs. 11—16; EHRENB. *Organisat., Systematik,* &c. 1830. Tab. VII. fig. 1, *Infusionsth.* Tab. LX. fig. 4; DUJARDIN, *Infusoires,* Pl. 17, fig. 1.

This Wheel-animalcule was first discribed and figured by LEEUWENHOECK in 1702. (*Sevende vervolg der Brieven,* 144 *ste Missive,* bl. 406). He observed

[1] *Tableau élémentaire,* 1798, p. 653.

that this animal, which he had found in a leaden gutter of his house, after it had been dried with the sand and other matters that adhered to it, revived again, when after two days he poured water upon it, which, having been previously boiled, could contain no living animalcule. He afterwards found that the same phenomenon occurred after a lapse of five months (bl. 413). Different observers repeated these experiments. FONTANA found Wheel-animalcules that had been dried for two years and a half revive on being moistened (*Traité sur le venin de la Vipère* I., Florence, 1781, 4to. pp. 90, 92), and SPALLANZANI saw the waking from slumber occur even after four years (*Opuscules de Physique, traduits par* J. SENEBIER, Genève, 1777, II. p. 310). The last-named observer saw the same phenomenon many times in succession; nay, even eleven times he saw alternately apparent death and life. A few minutes are often sufficient to revive the creatures; but such alone as were surrounded with sand and other matter, not those which lying quite bare had been dried, were revived. Observations in the present century also are not wanting, by DUTROCHET, C. SCHULTZE (according to EHRENBERG on *Philodina*), and others.

This phenomenon does not stand quite alone. We have spoken above of *Anguillula* (p. 194), and SPALLANZANI observed the same phenomenon in a microscopic aquatic animal, which he named *Tardigrade*, and which has been called *Arctiscon* by other writers. DUJARDIN brings this and other similar animals as well as the Wheel-animalcules into the same class of *Systolides;* but we are of opinion that they ought rather to be placed, as very imperfect forms of *Arachnoïdea*, with the *Acari*. It is on these *tardigrades* that DOYÈRE not long ago performed his very interesting experiments, and also, after most perfect desiccation of the animals when quite uncovered, succeeded in reviving them (*Ann. des Sc. nat.* 2e série, 1842. Tom. XVIII. *Zoologie*, pp. 5—35).

To these observations no exception can well be taken; the facts must either be stoutly denied or be accepted as we find them. SPALLANZANI asserted incorrectly that life was quite gone, and that a real revival occurred (l. l. p. 322). LEEUWENHOECK expressed himself more cautiously. BONNET too speaks of a seeming death, and says that life is not quite extinguished (*Consid. sur les corps organisés, Œuvres,* Neuchatel, 1779, 8vo. VI. p. 224, *Contemplation de la nature,* ibid. Tom. VIII. p. 262). VON HUMBOLDT calls the state of apparent death in these animals one of sleep, or of suspended life (*Versuche über die gereizte Muskel- und Nervenfaser,* 1797. 8vo. I. s. 296). In this desiccated state life is potentially present, but does not announce itself by actual phenomena. If we choose to name this life *latent,* we must not call death itself a *latent life;* certainly these animals are not dead, but their life is brought to a stand by the want of one of the most common and most necessary of vital stimuli, by the want of water.

# CLASS VII.

## RINGED WORMS (*ANNULATA*)[1].

LINNÆUS placed (vid. p. 30) all animals that are destitute of a proper internal skeleton in two classes, that of Insects and that of Worms. In reviewing the principal modifications which subsequent writers have introduced into the general classification of the animal kingdom, we find that they relate chiefly to the animals placed by LINNÆUS in the latter class. All those classes which we have hitherto treated of have been formed by separation from the LINNÆAN class of worms; all the animals which we shall describe in the sequel as Molluscs formed collectively a portion of the same great division. Amongst creatures so numerous and of such variety of form, there are some which in type, or plan of organisation, approximate towards insects; they are, like insects, articulate animals, but differ from them by the absence of articulate feet. As early as the end of the last century CUVIER made of these a distinct division of the animal kingdom under the name of Worms, and, at

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[1] Compare on this class :—

O. F. MUELLER, *Vermium terrestrium et fluviatilium seu Animalium infusoriorum, helminthicorum et testaceorum, non marinorum, succincta Historia,* Hauniæ et Lipsiæ, 1773, 1774, II Volumina 4to. (This work describes the Worms of LINNÆUS, that is, the invertebrate inarticulate animals and the ringed Worms.)

O. F. MUELLER, *Naturgeschichte einiger Wurmarten des süssen und salzigen Wassers,* mit Kupf., Kopenhagen, 1771, 4to. (new edit. 1800). Descriptions and observations referring chiefly to the genera *Naïs, Nereis* and *Aphrodite.*

J. C. SAVIGNY, *Système des Annelides, Description de l'Egypte,* Tom. XXVI. Paris, 1826, (pp. 325—472).

AUDOUIN et MILNE EDWARDS, *Classification des Annelides et Description de celles, qui habitent les côtes de la France. Annales des Sc. natur.* Tom. XXVII. 1832, pp. 337—447, Tom. XXVIII. 1833, pp. 187—247, XXIX. pp. 195—269, pp. 388—412, XXX. pp. 411—425.

MILNE EDWARDS, *Annelida* in TODD'S *Cyclopædia* I. 1835, pp. 164—173.

A. S. OERSTED, *Grœnland's Annulata dorsibranchiata* in *Kongl. Danske videnskabernes Selskabs Naturvidenskabelige og mathematiske Afhandlinger* X. 1813, pp. 153—216, with figures.

A. E. GRUBE, *Die Familien der Anneliden, Ein Systematisches Versuch.* Berlin, 1851.

the same time, added to it the *Entozoa*[1]. Some years afterwards CUVIER discovered that many of these animals have red-coloured blood, and thought that a name implying this was justifiable (*vers à sang rouge*), whilst LAMARCK, on account of the rings into which their body is divided, named them *Annelides*.

It was necessary to premise these historical notices in order to make it clear why we have given to this class of animals the name "Ringed Worms;" and, notwithstanding, include in it animals whose body is not divided into rings. The name may be defended by similar instances from other classes of animals, where names do not always suit all the individuals in them[2]. But, further, we prefer this name to that of "Worms," because this last is too indeterminate, and, as has been alleged above, has a double meaning.

One of the best writers on the *Annulata* is O. F. MUELLER, to whom the whole of Zoology is indebted for distinguished services. The immortal PALLAS, also, described many ringed worms, and investigated them anatomically. In the present century they have been especially investigated by SAVIGNY, MILNE EDWARDS, GRUBE and OERSTED. EHRENBERG has placed some of these worms, on account of the vibratile cilia with which their integument is beset, in a separate class, under the name *Turbellaria*. But, besides that we think too great a multiplicity of classes is to be avoided, some of these *Turbellaria* approach far too nearly to other natural divisions of the *Annulata* to allow us to place them in a distinct class of the animal kingdom[3].

CUVIER and LAMARCK placed the *Annulata* higher in the animal kingdom than the rest of the articulates; above the Crustaceans. It is true that the last-named Zoologist considered the Crustaceans to be the more highly organised, but believing that the *Annulata* ought to stand above the Insects, and that it was inexpedient to break the connected series formed by the Insects, Arachnoïds, and Crustaceans,

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[1] *Tableau élément. de l'Hist. nat. des Animaux*, 1798, p. 624; *Leç. d'Anat. comparée* I. IV*ième Tableau*. LAMARCK adopted the same class in his *Système des Anim. sans vertèbres*, 1801, p. 315.

[2] The class of the *Acalephæ* for instance, the order of the *hemiptera*, a name which is properly applicable to the division of the *heteroptera* alone.

[3] In the following general view of the internal structure of this class we shall especially fix our regards on those animals which indicate most clearly the articulate *type;* for the rest we refer to the special notices in the Systematic Arrangement.

by the *Annulata*, he preferred to place these last at the top. We are quite as ready to acknowledge that Articulates with articulate feet form a single connected series, and would not therefore separate them from each other; but we place the *Annulata* below the Insects, not above the Crustaceans. This arrangement, formerly adopted by us when it was less common, appears now to be generally received; even by Frenchmen, as, for instance, MILNE EDWARDS.

The body of ringed-worms is generally much elongated and cylindrical; in some instances it is broader and oval. It is divided by transverse folds into rings or girdles, which, in most species, are very numerous, and in one and the same species may vary greatly in number, at least when that number is very great. The common Leech has about 100 such, *Eunice gigantea* above 400; in *Phyllodoce laminosa* SAV., AUDOUIN and MILNE EDWARDS found nearly 500 rings, whilst in other individuals of the same species there were sometimes only 300. The integument is always soft, not corneous, but some of them live in sheaths or shells, sometimes compacted with bits of shell or grains of sand into a mosaic work of considerable strength, and sometimes consisting of calcareous matter, as in the genus *Serpula*.

In some the head is not distinct from the succeeding rings of the body. In others it is distinguished from the trunk by its different form, and is provided with eyes and even with threads, which many authors name Antennæ, after the so-named parts in Insects and Crustaceans; but they differ from these, and can be pushed in and out like the horns or feelers on the head of snails. The number of these feelers differs; there are rarely more than five, and some species have only a single thread of the kind.

On the rings of the body spines or hairs are usually set, which however may be entirely wanting in some, as in the leech. In most the hairs or spines are placed upon minute lateral tubercles, which may be considered as rudiments of feet. These rudimentary feet are, however, never jointed as in insects. They are usually divided into two parts, which may be named oars or fins; one on the dorsal surface, another on the ventral surface (*rame dorsale et rame ventrale* SAVIGNY). On each of these two projections a bundle of hairs (*setæ*) is set, of very different form; and, besides this, each projection has, as the rule, a conical spine that can be retracted into its sheath and is called needle (*acus*). Moreover, at the

base, or foot-piece of each of these oars there is usually placed a filiform appendage (*cirrus*). In the Dorsibranchiates there are found, in addition, on the dorsal surface towards the sides and near the oars, or upon them, the external respiratory organs, *Gills*, of various forms; sometimes divided like a comb, or branched like a tree, sometimes composed of simple filiform appendages resembling the *cirri* of the oars. In other ringed-worms the gills are situated at the most anterior part of the body. In the Leech, the Earth-worm, and allied genera, no respiratory organs are visible externally.

In those ringed-worms that have not a distinct head, the mouth is usually found quite at the anterior extremity of the body; in the rest it is situated on the inferior surface, and usually a muscular proboscis can be everted (*Phyllodoce Nereis*, &c.). In these, moreover, the mouth is ordinarily armed with horny jaws, placed laterally, differing in number in the different genera. Occasionally the number is not the same on the two opposite sides. Thus the genera *Œnone* and *Aglaura* SAV. have four jaws on the right, five on the left; *Lysidice* and *Leonice* three on the right, and four on the left.

The intestinal canal is, for the most part, straight, yet there are exceptions. In *Sabella ventilabrum* the canal makes a great number of transverse flexures, lying upon one another, and winding sometimes to the right, sometimes to the left: the first portion alone, the œsophagus, is straight[1]; GRUBE observed the same disposition in *Cirratulus*[2]. In *Amphictene* (*Amphitrite auricoma belgica* CUV.) the intestinal canal makes two flexures, as in *Holothuria*, first proceeding backwards, then straight forwards, and then backwards again with a narrower portion between the two others[3]. In the remainder, where the canal is straight, there are usually lateral appendages, or it is as though divided into cells by transverse constrictions. In the Earth-worm a short round stomach succeeds to the œsophagus, and then there is another muscular stomach. In *Arenicola* the middle wider portion of the intestinal canal has very thin walls, and is covered with very regular vascular reticulations

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[1] MECKEL, *System der Vergl. Anat.* IV. 1829, s. 71, R. WAGNER in OKEN'S *Isis*, 1832, s. 657, Tab. X. fig. 13.

[2] A. E. GRUBE, *Zur Anatomie und Physiologie der Kiemenwürmer*, Königsberg, 1838, 4to. s. 34.

[3] PALLAS, *Misc. Zoolog.* p. 129, Tab. IX. figs. 12, 13.

dividing it, as it were, into cells. Two conical yellow cœcal pouches are placed at the commencement of this portion of intestine: they may probably be considered to be rudiments of the liver. In the common Leech, the short œsophagus, of an oval form, wider towards the middle of its length, passes into a long stomach, which is divided by transverse walls into eleven portions: on each side are seen ten cœcal appendages to the stomach, the last of these being the longest; the inferior opening of the stomach (*Pylorus*) extends, like a funnel, into the intestine by a narrow opening. In other genera of *Hirudinea*, ex. gr. in *Hæmopsis*, the intestinal canal is more simple, having only two cœcal appendages[1]. In *Aphrodita* there succeeds to a very muscular cylindrical tube, which PALLAS described as stomach, a thin intestinal canal of considerable width with about twenty cœcal appendages on each side[2]. These appendages are narrow at their insertion into the intestine, wider in their middle, where they are provided with branched lappets, and terminate in longish cœcal sacs. This structure recalls the disposition of the intestinal canal in *Planariæ* and *Distomata*, and the blind branched appendages of the intestinal canal in Star-fishes may be compared with it. They are filled, as these are, with yellow fluid, and may be compared to rudiments of liver. In other animals again the liver appears as a protrusion of the intestinal canal.

The system of Blood-vessels presents very many modifications in this class. As to the blood itself, we have seen above, that CUVIER believed it to be red in all the ringed-worms. Such is really the case in by far the greater number, as *Hirudo*, *Lumbricus*, *Arenicola*, *Nereis*, *Terebella*, *Serpula*, &c.: in others it is nearly colourless, as in *Aphrodite:* yellow, as in *Polynoë* and *Phyllodoce*, or even green, as MILNE EDWARDS found it in a species of *Sabella*. The general arrangement of the circulating apparatus is as follows: there are two main stems, one on the dorsal surface, the other on the ventral surface, which run in the midst through the whole length of the body, and as far as the course of the blood could be determined in the living body—(for which investigation small individuals are frequently more fitted than large ones, on account of their

[1] See a figure in BRANDT und RATZEBURG, *Medizinische Zoologie*, II. Bd. 1833, Tab. XXIX. B. fig. 12.

[2] PALLAS, l. l. Tab. VII. fig. 10 *d*, *d*, fig. 11 *g*, *g*. G. R. TREVIRANUS in *Zeitschrift für Physiologie* III. 1829, s. 159—161, Tab. XII. fig. 9.

transparency), the blood moves in the dorsal vessel from behind forwards, in the abdominal vessel from before backwards[1]. In the Earthworm (*Lumbricus*) the two trunks are united in the anterior part of the body by five or more (7—9) arches widened like strings of pearls. (It is almost impossible not to recall here the vascular arches which in the embryos of mammals run along the branchial fissures.) In others the connexion forwards is effected by vascular plexuses (*retia mirabilia*)[2]. The dorsal vessel is usually considered to be arterial, the abdominal venous: and in most of the ringed-worms this opinion is not without ground, as might indeed have been concluded from analogy with other articulates. Sometimes the anterior part of the dorsal vessel becomes wider, resembling a rudiment of a heart, which then is in most cases an arterial heart like that of spiders and crustaceans. The exception however observed by MILNE EDWARDS must not be forgotten; in *Terebella* the heart drives the blood to the gills, and must therefore be considered to be a venous heart, analogous to that of fishes.

Other less important modifications of the vascular system consist in the breaking up of the two main stems into several, which are sometimes quite separate from each other, though placed in proximity (*Nephthys*, *Eunice*), or in the presence of lateral longitudinal stems. In *Pleione carunculata* there are as many as seven longitudinal stems: *four* on the ventral surface, of which the middle ones are small and lie at the sides of the nervous system, and the two outer which are larger and give twigs to the gills, and *three* on the dorsal surface, of which the two lateral receive the blood from the gills, and are connected by transverse branches with the third or median trunk[3]. In the Leech there are four principal stems, one dorsal, one abdominal, and two, larger than these, lateral.

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[1] In this simple fundamental form the vascular system presents itself in *Naïs*, where an arched vessel at the anterior extremity of the body unites the two longitudinal vessels. GRUITHUISEN, *Anat. der gezüngelten Naïde. Nov. Act. Acad. Cæs. Leop.* Tom. XI. p. 233. And *Ueber die Naïs diaphana*, ibid. Tom. XIV. pp. 407, &c.

[2] In *Nereis:* see H. RATHKE, *de Bopyro et Nereide commentationes duæ*, 1837, 4to. who calls these parts *organa reticulata*. MILNE EDWARDS, *Ann. des Sc. nat.* 2e Série, Tom. X. *Zool.* 1838, Pl. 12, fig. 1. Similar vascular plexuses exist also in *Pleione carunculata*, see G. R. TREVIRANUS, *Beobachtungen aus der Zool. u. Physiol.* Bremen, 1839, s. 54, and A. E. GRUBE, *De Pleione carunculata Diss. Zootom.* Regiomonti Prussor. 1837, p. 19.

[3] GRUBE, *De Pleione carunculata*, pp. 18, 19. On the circulation in the ringed-worms I. MUELLER in BURDACH'S *Physiologie* IV. 1832, s. 143—149, may be also

Respiration is effected by the skin, or by external gills of very different form, or by vesicles on the sides of the body. In the Leech there are found about seventeen such vesicles on each side, which open on the abdominal surface. The openings are extremely minute, and between two of them on each side there are four rings or segments of the body without such openings. A white convoluted structure is connected with these vesicles by means of a thin pedicle, and contains (according to DUGÈS) a blood-vessel in its interior. That these vesicles secrete mucus, is no proof that they are not respiratory organs; some writers think that it is their sole function to supply that secretion; and BRANDT believes that respiration in the Leech is effected by the skin. At all events, though these vesicles receive and return blood-vessels, they have not a perfectly separate circulation of blood in them, and the respiratory organs would seem to receive in this case, as in that of Reptiles, a portion only of the venous blood. In the Earth-worm there are more than a hundred such vesicles; their openings are on the abdominal surface, according to LEO and DUGÈS, whilst MECKEL and MORREN think that they are connected with a single series of apertures on the dorsal surface, which WILLIS formerly described and compared to the spiracles of Insects[1].

The ringed-worms, until within the last few years, were supposed, almost universally, to be bisexual. It was only in the *Aphroditæ* that a separation of the sexes was, with some hesitation, accepted, when PALLAS had shewn that certain individuals were full of eggs at the same time that in others the cavity of the abdomen contained a tenacious milky fluid[2]. Afterwards RATHKE also found a separation of the sexes in *Amphitrite*[3], and QUATREFAGES observed the same in a large number of marine ringed-worms (*tubicolæ* and *errantia*)[4]. The observations of STEENSTRUP on *Lepidonote*, *Phyllodoce*, *Nereis*, *Nephthys*, *Terebella*, and *Serpula* are to the same effect: in the last genus the sexual distinction may be recognised by the

consulted, and especially MILNE EDWARDS, *Ann. des Sc. nat.* sec. Série, Tom. x. pp. 193—221, Pl. 10, 11. (These figures are also transferred to the new edition of CUVIER, *Règne Animal, Annelides*, Pl. 1, &c.)

[1] *De Anima Brutorum*, Amstelodami, 1674, 8vo. pp. 34, 35, Tab. IV. fig. 3.

[2] *Misc. Zool.* p. 90.

[3] *Beiträge zur vergl. Anat. u. Physiol.* Danzig, 1842, s. 66—68.

[4] MILNE EDWARDS, *Rapport sur une Série de Mémoires de* M. A. DE QUATREFAGES, *Ann. des Sc. nat.* 3ième Série I. p. 21.

colour shining through the skin, which is white in male individuals and reddish in female. Other differences of external appearance in the two sexes are not known, unless we except an observation of OERSTED, which however is not altogether free from doubt, according to which in a new genus very nearly allied to *Syllis*, which he names *Exogone*, the male individuals are distinguished by longer hairs, as they are in the genus *Naïs*[1]. There still remain the genera of the *Hirudinea* and *Lumbricini*, in which STEENSTRUP indeed adopts separation of sex under similar external form of the parts: but this requires confirmation after accurate investigation, for it is in conflict with earlier observations, whilst by later it is in part contradicted[2]. On the whole, no common type can be assigned for the genital organs: for the most part, there are some pairs of vesicles (*ovaria*, *testes*) in the fore part of the body. In some *Annulata setigera*, apertures at the base of the foot-swellings have been seen, through which passes seed or eggs: but in many of them such an outlet is still unknown. For the most part, external genital organs are deficient: neither does copulation occur, except in *Lumbricini* and *Hirudinea*.

The development of the egg has been investigated only in a few species. Here also that remarkable cleaving and successive division of the yelk has been observed, which RUSCONI and VON BAER first detected in the eggs of frogs and of fishes. The development of the embryo begins on the abdominal surface, and the yelk lies on the dorsal surface, as in Crustaceans and Insects: two abdominal streaks are observed at the commencement of development, which recall the dorsal plates of vertebrate animals[3].

The most recent times have made us acquainted with some remarkable metamorphoses in the course of the development of ringed-worms. LOVEN found the first stage in a worm of the family of the Nereids (probably a species of *Phyllodoce*) to resemble

[1] ERICHSON'S *Archiv f. Naturgesch.* 1845, I. s. 20—23.

[2] See F. MUELLER on the Hermaphroditism of the *Hirudinea*, in the German translation of STEENSTRUP'S work cited above (p. 135) *Untersuchungen ueber das Vorkommen des Hermaphroditismus in der Natur.* Greifswald, 1846, s. 110—114.

[3] Most of the observations refer to *Hirudinea*. Such are the following works:—E. H. WEBER, *Ueb. die Entwickelung des medicin. Blutegels*, MECKEL'S *Archiv.* 1828, s. 366—418, Taf. X. XI.; R. WAGNER, *Bruchstücke aus der Entwickelung des gemeinen Blutegels, Hirudo vulgaris* L., *Nephelis tesselata Sav.* OKEN'S *Isis*, 1832, s. 398—408, Taf. IV.; A. E. GRUBE, *Untersuchungen ueber die Entwickelung der Clepsinen.* Mit 3 Kupfert. Königsberg, 1844. We may expect several observations on marine *annulata* from QUATREFAGES. See *Ann. des Sc. nat.* 3ième Série, *Zoologie* I. p. 21.

a hemispherical or conical body of about ½ millim. terminating in a ciliated disc on whose edge the mouth seemed to be placed. At the pole of the hemisphere was the anus. This conical body increased gradually in length and became divided into rings gradually more numerous, the last formed ring being that next the disc (just as in ESCHRICHT'S observations on *Bothriocephalus* the new rings were formed in the anterior part of the body). Each ring originally consisted of four pieces: an anterior and a posterior piece being larger, almost a semicircle, and a smaller piece on each side connecting them. The disc with its vibrating cilia diminished gradually and became changed into two fin-like appendages to the head, from which the feelers probably proceed[1]. SARS saw the incipient form of *Polynoë cirrata* as a short, oval, inarticulate body with a transverse circle of vibratile cilia round the middle[2]. It may be confidently asserted therefore that there is a *metamorphosis;* parts are present which afterwards disappear (the vibratile cilia), others are deficient which are afterwards developed, and the entire form is changed.

The Reproductive force is, in some animals of this class very great, in others small, although worms that have been cut through transversely continue to live for a long time, as has been observed in the leech, and by O. F. MUELLER in *Nereis versicolor*. TREMBLEY'S experiments on the Fresh-water Polyp induced BONNET to repeat them on Fresh-water Worms (*Naïdes*), and he found that the pieces he had cut off grew into new worms[3]. MUELLER also succeeded in similar experiments[4]. It has been thought also that they have succeeded in the Earth-worm, but here they have constantly failed with other experimenters. According, however, to the experiments of DUGÈS a few rings at the anterior part of the body may be reproduced and gradually changed into a head[5].

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[1] S. LOVEN, *Zoologiska Bidrag; Metamorphos hos en Annelid* (*Aftryck ur K. Vetensk-Akadem. Handlingar*, 1840); translated into most of the zoological journals: *Ann. des Sc. nat.* 2e Sér. XVIII. p. 288.

[2] ERICHSON'S *Archiv.* 1845, I. s. 11—19, Tab. I.

[3] *Observations sur quelques espèces de Vers d'eau douce; Œuvres* (édit. 8vo.) pp. 167, &c. Especially in *Lumbricus variegatus* MUELL. (*Lumbriculus variegatus* GRUBE) is this reproductive power great, in which BONNET saw the amputated head renewed eight times in two months.

[4] *Von Würmern des süssen u. salzigen Wassers*, s. 43, 82, &c.

[5] *Ann. des Sc. nat.* XV. 1828, pp. 317, 318.

The Nervous System in the *Annulata* proper consists, as in Insects, of ganglia connected by two cords and placed behind each other in a series in the middle of the body on the abdominal surface. Originally each ganglion consists of two lateral portions, as is proved by the process of development: on the regeneration also of parts that have been cut away the nervous system appears to be formed of two lateral portions. A larger ganglion lies in the head, and is connected, by two nervous threads that form a ring around the œsophagus, with the first ganglion of the abdominal chain. But the Nervous System presents much variety in different genera, as well in the number as in the greater or less development of the ganglia and in the nerves that spring from them; whilst in the earth-worm, for instance, the numerous ganglia of the abdominal chain almost touch each other, in the leech they are only twenty-four or twenty-five in number, and are placed far asunder, especially in the middle. In *Pleione carunculata* the Nervous System consists, according to GRUBE, besides the middle chain, of two lateral cords, also with ganglia, which are connected with the former by transverse threads[1]. In *Eunice sanguinea* QUATREFAGES found minute ganglia at the base of the rudimentary feet, which however were not connected, as a chain, by longitudinal filaments. In addition to this nervous apparatus a special nervous system has been detected in many instances, agreeing with that portion of the nervous system in Insects which has been compared to the *Nervus sympathicus* of the higher animals: of which we shall treat more at large at the class of Insects. In *Hirudo medicinalis* BRANDT discovered three minute ganglia in the head, which are united by threads with the cerebral ganglion, and from which the maxillary nerves arise; with the middlemost of the three ganglia a nerve is probably in connexion, which runs beneath the stomach in a longitudinal direction and finally divides into two branches; but this nerve differs from the sympathetic of insects in respect of its position on the inferior surface. In *Eunice sanguinea* and some

[1] *Diss. zootom. de Pleione carunc.* p. 9, figs. 1, 5. STANNIUS (*Isis*, 1831) observed the same thing in another species of *Pleione* (*Amphinome rostrata*). It is as though there were a repetition of the form of the vascular system on the dorsal surface, which here consists of three stems; see above (p. 212). Perhaps this arrangement occurs in several *Annulata;* at least WAGNER describes it also in *Pontobdella muricata, Lehrb. der vergl. Anat.* 1835, s. 381.

*Nereidæ* QUATREFAGES found this system to be composed of different ganglia, and named it, on account of its position on the proboscis, *système susœsophagien*, or *proboscidien supérieur*[1].

With respect to organs of sense, with the exception of tentacles and other appendages subservient to a finer sense of touch, for sight there are found in most species only coloured spots, usually black, of variable number, as special organs. According to J. MUELLER'S investigations in a *Nereis*, the eyes of ringed-worms contain no transparent parts, but are merely swellings of the visual nerves surrounded by black pigment. They are endowed with sensibility for light, and the worms can distinguish between light and darkness: but what is properly named *sight*, perception of the form of objects, such eyes cannot afford. In *Alciopa lepidota* KROHN however found a lens and a vitreous body. A special auditory organ has not been detected; the first portion of the œsophagus is supposed to be the seat of taste.

The organs of motion are in some more complicated than in others. In all muscular fibres are found beneath the skin, which may be separated more or less completely into layers: the external layer has a circular, the internal a longitudinal course. In some, as *Aphrodite*, these fibres are united to form distinct bundles. By means of the layers or bundles the body can be moved, contracted, extended, bent. Besides this general muscular system, motion of the body in the Leech can be also effected by means of a suctorial disc at its posterior part, in which there are circular and radiating fibres. The proboscis, which is capable of eversion and retraction, has proper muscles for these purposes. Concerning the bristles and hairs, which are found on many, we have already spoken above. These parts, springing from the sides, supply fixed points for the motions of the body, like the spines of the *Echini*: they are retracted, extended or moved sideways by proper muscles.

Many species of this class diffuse a phosphoric light. It is

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[1] There lies also a small ganglion in front of the brain (*ganglion cervical* QUATREFAGES), and from the lateral parts of the brain a thread arises, which with that of the other side surrounds the mouth (*Système sous-œsophagien labial au proboscidien inférieur*); this last portion of the nervous system may be compared with the arrangement in the *Mollusca gasteropoda*. See on the nervous system of the *Annelids* a memoir of QUATREFAGES illustrated with beautiful figures, *Ann. des Sc. nat.* 3e Série, Tom. II. *Zoologie*, 1844, pp. 81—104.

asserted that this phenomenon has been occasionally observed in the earth-worm (*Lumbricus terrestris* L.) It is quite certain that it has been seen to occur in very many marine *Annelides:* and hence these are creatures also which contribute to the illumination of the sea. *Nereidæ* are especially noted in this respect: DUGÈS observed the phenomenon in a Mediterranean species 4″ long, *Syllis fulgurans*[1]. QUATREFAGES made the important discovery that, in certain minute marine *Annelides* (species of *Syllis* and *Polynoë*), the seat of the phenomenon is at the base of the feet-tubercles—in fact in the muscles: it was only when the muscles contracted that the light appeared like an electric spark[2].

Ringed-worms are found in all countries and seas: but it is impossible to present a view of the geographical distribution of the species hitherto known, for this class is perhaps more generally neglected by voyagers than any other, and we are acquainted with few marine *annelides* except those from the Atlantic ocean, the Mediterranean, and the Red sea. Of the genus *Palmyra* only one species is known, which was found at the Mauritius. From the Indian sea some large and beautiful species are known, as *Laodicea gigantea; Serpula gigantea* is from the West Indies: and, in general the large and beautiful species are most numerous in warm regions. Some species appear to have a very wide geographical distribution, as *Hesione splendida*, found by SAVIGNY in the Red sea, and brought by MATTHIEU from the Island of Mauritius: and *Pleione carunculata*, which, according to PALLAS and SAVIGNY occurs in the American seas, according to SEBA in the Indian sea, and was found by GRUBE in the Mediterranean at Sicily. The *Hirudinea* and *Lumbricini* have scarcely been investigated elsewhere than in Europe.

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[1] *Ann. des Sc. nat.* Tom. XXIX. p. 229. The *Nereis noctiluca* L. is a small animalcule, probably the same species as *Nereis cirrigera* of VIVIANI. *Polynoë fulgurans*, at most half a line long, was observed and figured by EHRENBERG, *Leuchten des Meeres*, Tab. I. fig. 1.

[2] *Ann. des Sc. nat.* sec. Série, XIX. 1843, *Zoologie*, pp. 183—192.

# SYSTEMATIC DISTRIBUTION OF ANNULATA.

## CLASS VII.

### ANNULATA.

ANIMALS elongate, living in waters or moist earth, not parasitically in other animals, mostly articulate, without jointed feet, but often in place of feet supplied with setæ or setiferous tubercles which are retractile. Respiration effected either by external branchiæ or internal sacs or by the skin itself. Organs of circulation in most distinct; contractile vessels instead of heart. The nervous system composed of a cephalic ganglion single or double, and most frequently of a double ventral cord with ganglia at intervals.

#### ORDER I. *Turbellaria.*

Body cylindrical or depressed, most frequently inarticulate, or ringed by transverse rugæ, beset with vibratile cilia.

Family I. *Planariecæ.* Nutrient canal with one distinct aperture alone, anus none. Body inarticulate.

This family was originally formed from the genus *Planaria* of O. F. MUELLER, which was divided by later writers into other genera, and round which in consequence of new discoveries other different genera were arranged. It appears to us to be inconsistent with the idea of a class, to raise this group to that rank, as VON SIEBOLD has done, who has formed his class of the *Turbellaria* of it alone. The name *Turbellaria* was first, though in a more comprehensive sense, used by EHRENBERG[1] (see above, p. 208). The phenomenon of rotatory motion in the water surrounding these animals, which gave

[1] *Symbolæ physicæ Anim. evertebrata exclusis insectis*, I. Berolini, 1831, fol.

occasion to the name, was first, as it seems, observed by DUGÈS in *Planariæ*, although he did not refer it to cilia (*Ann. des Sc. nat.* Tom. XV. p. 165), whilst VON BAER observed at the same time another phenomenon which could only be an effect of these cilia, that when a portion of these animals is cut off it continues to rotate circularly in the water (*Nov. Act. Acad. Cæsar. Leop. Carol.* Tom. XIII. P. 2, p. 711).

The internal structure of these creatures was first recognised with precision in this century, especially through the investigations of DUGÈS, V. BAER, FOKKE, OERSTED, and QUATREFAGES; it presents important differences in different *genera* whilst the external *habitus* is similar. We must confine ourselves to the notice of a few general traits.

Besides the cilia on the external surface, the external integument in many is distinguished by the presence of cells with nettle-threads, like as we stated in Acalephæ. Beneath the integument there is a layer of transparent, homogeneous tissue, which, according to QUATREFAGES, supplies, as it seems, the place of muscle, and by its contraction effects the movement of the body. The motion occurs by swimming in the water, the lateral margins beating to and fro, by creeping with bending and straightening of the body, or by equably gliding, much as the gasteropod molluscs move with their so-named foot.

The oral aperture is sometimes more forward, sometimes more in the middle of the body on the ventral surface. The intestinal canal is in some straight, and extends itself, when the mouth is not placed quite forward, anteriorly as well as posteriorly, with blind terminations in both directions. In others the intestinal canal is like a tree divided into branches; in our fresh-water species one branch is seen to run forwards, on both sides provided with blind appendages, and two stems or main branches backwards at the sides of the body (in *Planaria lactea* the branches may be readily distinguished externally by their dark colour). In other species from sea-water the division of the branches is somewhat different; sometimes quite retiform. In the cavity of the mouth is situated a part that can be extended by eversion, serving for the seizure of food, and various in form. It is able, when severed from the living creature, to move independently for some time whilst it swallows greedily surrounding substances which are seen to pass out by the posterior open extremity as through a funnel. With respect to the vascular system little is known; that which is described as such by some writers,

belongs probably to the nervous system. In some species with straight intestinal canal, there have been observed at the sides two tortuous canals running longitudinally, which, without giving off lateral branches, bend round in a loop at the back part. Respiration is probably effected by the skin itself, and the water on the surface is constantly renewed by the vibratory motion.

As nervous system in many a double nervous ganglion has been observed, which lies at the anterior end, and from which many branches arise. The eyes, which are in some instances very numerous, present in many a transparent body, *corpus vitreum* or *lens crystallina*.

The reproductive power is very great, and severed parts grow, as appears from the observations especially of DUGÈS and J. R. JOHNSON, to new animals. In some propagation occurs by spontaneous division. The sexual organs have one common or two separate openings behind the mouth; in the latter case the anterior opening belongs to the male organs of copulation. Two long tubes supply the office of *testes*, and end as *vasa deferentia* in a seminal vesicle, with which a penis of various form is connected. The *spermatozoa* have been observed by QUATREFAGES and VON SIEBOLD. A double oviduct leads to a spacious vagina, into which two special hollow bodies also open. The eggs lie dispersed in the parenchyme of the body, between the cœcal branches of the intestinal canal (QUATREFAGES), where probably they are contained in special ramified tubes (ovaries).

Compare on this family:

VON BAER, *Ueber Planarien. Nov. Act. Acad. Cæs. L. C. nat. cur.* Vol. XIII. P. 2, pp. 690—730.

DUGÈS, *Recherches sur l'organisat. et les mœurs des Planariées, Ann. des Sc. nat.* XV. 1828, pp. 139—187; *Observations nouv. sur les Planaires, ibid.* XXI. 1830, pp. 72—92.

A. S. OERSTED, *Entwurf einer systematischen Eintheilung und speciellen Berschreibung der Plattwürmer. Mit Holtz-schnitten und 3 Tafeln.* Copenhagen, 1844, 8vo.

A. DE QUATREFAGES, *Mémoire sur quelques Planariées marines, Ann. des Sc. nat.* 3me Série, Tom. IV. 1845, *Zoolog.* pp. 129—184. Pl. 3—8.

M. S. SCHULTZE, *Beiträge sur Naturgeschichte der Turbellarien. Erste abtheilung. Mit Kupfertaf.* Greifswald, 1851, 4to, also in WIEGMANN'S *Archiv.* 1849. § 290.

Phalanx I. *Rhabdocœla.* Intestine simple, cylindrical, not exsertile from the mouth. Body elongate, roundish or depressed.

*Prostoma* OERST. (not DUGÈS), *Gyrator* EHRENB. Oral aperture anterior terminal.

Sp. *Prostoma lineare* OERST., *Gyrator hermaphroditus* EHRENB., *Abhandl. der Akad. der Wissensch. zu Berlin*, 1835, Tab. I. fig. 2.

*Vortex* EHRENB.

Sp. *Vortex truncatus, Planaria truncata, Zool. danic.* Tab. 106, fig. 1, *a, b*, EHRENB. l. l. figs. 3, &c.

*Derostoma* OERST. (DUGÈS in part).

*Mesostoma* DUGÈS, OERST. Body depressed, transparent; oral aperture annular, rotund, situated a little in front of or in the middle of the body. Eyes two anterior.

Sp. *Mesostoma Ehrenbergii, Planaria tetragona* MUELL., *Fasciola quadrangularis* PALL., *Spicil. Zool.* X. Tab. I. fig. 12; *Zool. danic.* Tab. 106, figs. 1—5; FOKKE, *Ann. des Wiener Museums*, I. 1836, pp. 191—206, Tab. XVIII. This species has been elaborately investigated by the last-named writer; it undergoes various changes of form; from the flat form a quadrangular arises, as though the animal were about to divide itself in the length. PALLAS had already observed this *Planaria* more than 70 years earlier at *Sorgvliet*, and it has lately been found again at Leyden by HERR HERKLOTS.

*Strongylostoma* OERST.

*Typhloplana* EHRENB.

*Macrostoma* OERST.

*Microstoma* OERST. (Vid. SCHULTZE quoted p. 203.)

*Convoluta* OERST.

Phalanx II. *Dendrocœla.* Nutrient tube branched. Body depressed. (*Dendrocœla* and *Cryptocœla* OERST.)

*a) Appendages numerous, tubular or papillæ on the back.*

*Thysanozoon* GRUBE, *Eolidiceros* QUATREF. Eyes sessile, numerous; body excised anteriorly and cloven into two tentacles.

Sp. *Thysanozoon Brocchii, Eolid. Brocchii* QUATREF. l. l. Pl. 5, fig. 1, (perhaps the same species as *Thysanozoon Diesingii* GRUBE, *Actinien, Echinodermen u. Würmer*, fig. 9); in the Mediterranean. The intestinal canal has here a retiform division.

*b*) *Body smooth.*

*Stylochus* EHRENB. Eyes numerous, all or most of them supported by dorsal tentacles.

*Leptoplana* EHRENB.

*Planaria* EHRENB. (Species of genus *Planaria* MUELL.) *Planaria* and *Dendrocœlum* OERST. Eyes two or a row of many eyes in the anterior margin of the body. Oral aperture in the middle of the body.

Sp. *Planaria lactea* MUELL., *Zool. dan.* Tab. 109, figs. 1, 2, *Planaria torva* MUELL., *ibid.* figs. 5, 6; *Planaria nigra* MUELL., figs. 3, 4, all in fresh-water.

*Polycelis* EHRENB. (and *Prosthiostomum* QUATREF.)

*Tetracelis* EHRENB.

*Tricelis* EHRENB.

*Monocelis* EHRENB.

*Note.*—On these, and some other genera all of which are not yet sufficiently limited, consult EHRENBERG *Symb. phys. Anim. evertebr. exclusis insectis*, I., and OERSTED l. l.

Family II. *Nemertini.* Nutrient tube simple, with double aperture, anus terminal. Body elongate, extremely contractile, roundish, or depressed, indistinctly annulate.

It is not without hesitation that, after OERSTED, we have given these characters of the family of the *Nemertini*, whilst amongst the different writers, with respect to the true nature of the distinct parts, a remarkable variety of opinion prevails, so that it is uncertain whether the aperture, considered as *anus*, really belongs to the intestinal canal. Beneath the skin in these worms muscular fibres are seen, of which the external layer runs longitudinally, the innermost annularly or transversely. A canal of uniform width, by many supposed to be the intestine, runs straight through the body (DELLE CHIAJE, HUSCHKE, RATHKE). On its dorsal surface lies a canal, which is closed at its termination backwards, becomes narrower forwards and ends in a long proboscis. This part is, according to QUATREFAGES, the proper intestinal canal, which consequently has no *anus*. HUSCHKE supposed it to be an organ of propagation (*testis?*) and the proboscis an external copulative organ; hence the

name *Notospermus*, which he gave to the worm examined by him. The *Nemertini* appear, according to RATHKE and QUATREFAGES, to have the sexes distinct, and the organs of propagation (*testes*, *ovaria*) consist of blind saccules, which lie beneath the integument longitudinally, upon the wide canal already described. There are three blood-vessels running longitudinally, two on the sides and more towards the ventral surface, and one on the dorsal surface, which divides anteriorly into two branches which pass into the lateral vessels. The nervous system consists of two head-ganglia united by a transverse cord, from which (besides other nervous branches) two very notable nerves arise, which run longitudinally backwards, along the sides of the body.

Compare for the anatomy of this family, besides OERSTED and the other writers cited above, DELLE CHIAJE, *Memorie* II. pp. 406—409 and 427, (extract by R. WAGNER in OKEN'S *Isis*, 1832, s. 555, 556, s. 647—649); HUSCHKE, OKEN'S *Isis*, 1830, s. 681—683, Tab. VII. figs. 1—6; RATHKE, *Beiträge zur vergl. Anat. u. Physiol.* Danzig, 1842, s. 93—104; QUATREFAGES, *l'Institut, Journal universel*, &c. No. 660, 1846, p. 286, and a figure in the new illustrated edition of CUVIER, *Règnè Animal, Zoophytes*, Pl. 34 (and also a *Mémoire sur la famille des Némertiens, Ann. des Sc. nat.* 3ième Série, Tom. VI. *Zool.* pp. 173—303).

*Nemertes* CUV., *Borlasia* OKEN. Several eyes (often indistinct). Two pits (respiratory?) at the sides of the head, surrounded with vibratile cilia.

Sp. *Nemertes Borlasii*, *Borlasia Angliæ* OKEN, BORLASE, *Nat. Hist. of Cornwall*, fol. 1758, Pl. XXVI. fig. XIII. (cited by CUVIER), QUATREFAGES in CUV. *R. Ani. édit. ill., Zooph.* Pl. 33; this worm becomes more than four feet long; &c.

*Note.*—OERSTED cites as synonyms of this genus *Notospermus* HUSCHKE, *Meckelia* LEUCK., *Ophiocephalus* QUOY and GAIM.

OERSTED has given the name *Borlasia* to species with constricted head, without respiratory fissures, with indistinct eyes. Add several genera, of which the synonyms cannot be made out except by comparison of the specimens: *Cephalothrix* OERST., *Astemma* OERST., *Tetrastemma* EHRENB., *Polia* DELLE CHIAJE, *Polystemma*, *Ommatoplea*, *Amphiporus* EHRENR., *Cerebratulus* RENIERI, *Amphiporus* OERST. (not EHRENB.), *Serpentaria* GOODSIR[1].

[1] *Descriptions of some gigantic forms of invertebrate animals, Annals and Magazine of Nat. Hist.* Vol. XV. 1845, p. 377, Pl. XX.

## Order II. *Suctoria.*

Body annulate, without setæ, terminated by a prehensile cavity posteriorly, or at both extremities. External branchiæ none.

Family III. *Hirudinea.* (The characters of the order are also those of the single family.)

The family of the blood-suckers (leeches) is formed from the genus *Hirudo* L. These animals are able to convert the anterior extremity of the body into a suctorial cavity, or have there, as at the posterior extremity, a round suctorial disc. They creep along the ground, by affixing this sucking apparatus and by alternately contracting and extending the body. They swim with a serpentine and sinuous bending of the body, which is effected with much velocity.

Comp. on this family Moquin-Tandon, *Monographie des Hirudinées, nouv. édit. av. pl. color.* Paris, 1846, 8vo.

*A.* Head made up of several segments of the body, slightly or not at all distinct from the rest of the body, capable of change into a suctorial acetabulum by its own motions.

*Clepsine* Sav. Body depressed. Mouth unarmed, furnished with a proboscis exsertile, tubular. Eyes 2—6 (sometimes eight?).

- Sp. *Clepsine hyalina, Hirudo hyalina* L., Trembley, *Polyp.* Pl. vii. fig. 7; *Clepsine complanata,* &c.

This animal lays its eggs on water-plants (*Stratiotes aloïdes*) and continues to sit thereon. The eggs also attain their development even when the mother is driven away, but are then frequently affected and spoilt by confervæ. These eggs are thin-skinned vesicles in which numerous yelk-spheres, 15 to 30, are contained, and from which a corresponding number of young are developed.

Comp. on the species of this genus F. Mueller, *De Hirudinibus circa Berolinum hucusque observatis,* Berolini, 1844, 8vo, and T. Budge, *Clepsine bioculata.* Mit 2 Taf. Bonn, 1849.

Under this genus F. Mueller also places *Hirudo marginata* and *Hir. tessulata* of O. F. Mueller, though the last has eight eyes, whilst in *Clepsine* the number does not exceed six; the arrangement of the eyes is in two rows longitudinally which meet forwards, just as in the six-eyed *Clepsines;* the blood also is white.

*Nephelis* Sav. Body elongate, posteriorly incrassated, obtuse, with acetabulum obliquely terminal. Mouth unarmed. Eyes eight, disposed in a series semicircular, transverse.

Sp. *Nephelis vulgaris, Hirudo octoculata* L., *Encyclop. méthod., Vers.* Pl. 51, figs. 5—7; STURM, *Deutschl. Fauna* VI. 2 Heft; JOHNSON, *Phil. Trans.* 1817, Pl. IV. (reprinted in his *Further Observat. on the Leech*, 1825); this species swallows small worms.

*Trocheta* DUTROCHET, *Trochetia* LAM. (*Geobdella* BLAINV. in part).

*Branchiobdella* ODIER. Body somewhat depressed, with large rings, not numerous. Two horny jaws. Eyes none.

Sp. *Branchiobdella astaci* ODIER, *Mém. de la Soc. d'Hist. nat. de Paris* I. 1823, pp. 69—78, Pl. IV. (already observed and figured by ROESEL, *Ins.* III. Pl. LIX. figs. 19—22[1]); *Branch. parasita*, comp. HENLE, *Ueb. die Gattung Branchiobdella*, MUELLER'S *Archiv.* 1835, s. 574, &c. Taf. XIV.

*Hirudo* L. (exclusive of several species). Body oblong, subdepressed, with numerous rings. Three horny jaws. Eyes usually ten.

*Bdella* SAV. Jaws not denticulate. Eyes eight.

Sp. *Bdella nilotica* SAV., GUÉRIN, *Iconogr., Annél.* Pl. 4, fig. 10.

*Hæmopis* SAV. Maxillæ armed with a double row of denticles not numerous. Eyes ten.

Sp. *Hæmopis sanguisorba, Hirudo sanguisuga* L., *Encyclop. méth., Vers.* Pl. 51, figs. 3, 4, black, grey-green beneath; this species is larger than the common Leech. Commonly two species have been here confounded, which MOQUIN-TANDON places in two different *genera: Aulastoma* (*Hir. sanguisuga* MUELL., *Hir. Gulo* BRAUN, STURM, *Deutschl. Fauna* VI. 2) and *Hæmopis* (*Hir. sanguisuga* BERGM., L.)

*Sanguisuga* SAV. Jaws armed with a double row of denticles very slender and crowded. Eyes ten.

Sp. *Hirudo medicinalis* L., *Hirudo venæsector* BRAUN, STURM, *Deutschl. Fauna* VI. 2 Heft; BRANDT u. RATZEBURG, *Mediz. Zool.* II. Taf. XXVIII. figs. 3, 4; GUÉRIN, *Iconogr., Annél.* Pl. 10, fig. 3; above, blackish-green, with six long stripes spotted reddish and black, beneath olive-coloured with many black spots (four to five inches long). Another species, *Hir. officinalis* SAV., is also used for medicinal purposes, which is yellowish beneath with a broad black edge, without spots, see BRANDT u. RATZEB. l. l. Taf. XXX. fig. 1; J. J. KNOLZ, *Naturhist. Abhandl. ueber die Blutegel*, Wien, 1820,

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[1] This genus must by no means be confounded with *Branchiobdellion* RUD., *Branchellion* SAVIGNY, which like *Clepsine* and *Nephelis* has no jaws, but only three projecting points; if the semicircular little plates on the same part of the body be really gills, as SAVIGNY says, (CUVIER doubts and MOQUIN-TANDON denies it,) then it does not belong to this order. LATREILLE places it near the genus *Arenicola*.

8vo. Tab. I. fig. 2; according to KNOLZ it is this species especially which is used in Vienna and brought there from Hungary[1].

*Hirudo medicinalis* is the most useful species of Leech (*sangsue, leech, Blutegel*), which almost everywhere in Europe lives in fresh water, especially in ponds, marshes and canals, and in winter, rolled up annularly, conceals itself in the mud. This animal lives on the blood of animals (*vertebrate* and *invertebrate*) exclusively; the jaws serve to wound and to penetrate the skin. The first segment of the body, which also is occasionally parted by a transverse stripe, has a semilunar form and is not closed beneath. It can extend itself as an upper lip for feeling or bend itself downwards to cover the mouth. The ten black eye-spots are arranged in form of a horse-shoe on the back-side of the head; the first on the first segment, the two next on the third, and the two last on the sixth ring of the body. The organs of propagation of the leech are by different writers determined very differently, whilst, however, the latest investigations (especially of H. MECKEL, MUELLER'S *Archiv.* 1844, s. 476—480) bring us back to the generally received opinion of former times. According to it, nine pairs of round vesicles of a white colour are *testes*, (TREVIRANUS thought they must be held to be ovaries, *Zeitschr. für Physiol.* IV. 2, 1832, s. 159—167). By means of short transverse tubules these vesicles are connected with a common canal which runs at each side of the body; this canal goes forward into a structure which is white and consists of many convolutions (the *epididymis* or the seminal vesicle). From each of these two seminal vesicles arises a short vessel (*vas ejaculatorium*), which runs to the spherically widened sheath of the penis: the penis can be everted outwards through an opening in the twenty-fourth ring of the body. In the fifth ring behind this is seen the second sexual opening, that of the female parts; it leads to a wide vagina (uterus, according to BOJANUS) which, by means of a tube that divides forwards into two branches, is connected with two small ovaries or vesicles filled with granular bodies. These two ovaries lie between the seminal vesicles and the vagina. The impregnation in Leeches is mutual. The Leech lays eggs, or rather capsules, in which eggs are contained, 5—16 in number. These capsules or cocoons are three-fourths of an inch long, oval and surrounded with a spongy or frothy substance, and filled with a brown albuminous fluid. The germs appear as round discs; these minute yelks grow by means of the surrounding albumen, which is absorbed by a structure which closely resembles a funnel-shaped œsophagus, and is already visible on the germ when only half a line in size (E. H. WEBER in MECKEL'S *Archiv.* 1828, s. 366—418, MUELLER'S *Archiv.* 1846, s. 428—434).

Comp. on the Leech amongst others: JOHNSON, *Treatise on the Medicinal Leech*, London, 1816, 8vo, and by the same, *Further Observat. on the Med. Leech.* With engravings. London, 1825, 8vo; KUNTZMANN, *Anatomische Physiol. Untersuchungen über den Blutegel*, m. 5 Kupfert.; BOJANUS in

[1] Other species still, which have been discovered, may be used for drawing blood, as the large black species spotted with white which was discovered in Sweden some years ago by WAHLBERG, and named *Hirudo albopunctata.*

OKEN'S *Isis*, 1817, s. 881 (with fig.), the same 1818, s. 2080; KNOLZ (see p. 226); BRANDT *Mediz. Zool.* II. 1833, s. 230—297; MOQUIN-TANDON *Monographie des Hirudinées*, &c.

Amongst the foreign species we note *Hirudo zeylanica*, found in the Island of Ceylon; its poisonous bite is followed by very tedious ulcers. TYTLER, *Edinb. new Philos. Journ.* 1826, p. 375.

*B.* Acetabulum of the mouth of a single segment, distinct from the rest of the body by stricture.

*Hæmocharis* SAV., *Piscicola* BLAINV., LAM. Body cylindrical, attenuated forward, with few rings, little distinct. Anterior acetabulum slightly excavate, with mouth triangular, edentulous, placed in the bottom towards the inferior margin; posterior acetabulum large, obliquely terminal.

Sp. *Hæmocharis piscium, Hirudo geometra* L., ROESEL *Ins.* III. Tab. XXXII.; LEO, *Ueber einige ausgezeichnete anatomische und physiologische Verhältnisse der Piscicola geometra*, MUELLER'S *Archiv.* 1835, s. 419—427, Taf. XI. This species lives in fresh-water and adheres very firmly to Carp, Tench, &c. It moves like a geometrical caterpillar; on the back-side of the cephalic disc are four black eye-spots; copulation occurs in the upright position, in which the animals support themselves on the ventral disc and embrace in form of an X. They lay eggs of a yellow-brown colour, three-fifths of a line long.

*Piscicola respirans* TROSCHELL, new species, *Archiv f. Naturgesch.* XVI. 1850.

*Pontobdella* LEACH, LAM., *Albione* SAV. Body cylindraceo-conical, attenuated forwards, with unequal rings. Acetabula very concave; mouth small unarmed, placed at the bottom of the anterior acetabulum; posterior acetabulum exactly terminal.

These animals live in the sea and adhere to different fishes, especially to Rays. Most of the species are beset with nodes or with warts on the rings, which are flatter in *Pontobd. verrucosa*, BASTER *Natuurk. Uitspanningen* I. Tab. X. fig. II., more pointed in *Pontobd. muricata* LEACH. In others these nodes are entirely absent, as in *Pontobd. lubrica* GRUBE; eyes seem not to be present.

## ORDER III. *Setigera.*

Body annulate, provided with setæ or with setigerous rudiments of feet. External branchiæ in most.

*A.* No external organs of respiration (*Abranchia*).

Family IV. *Lumbricini.* Branchiæ none. Body provided with setæ, without rudiments of feet.

*Chætogaster* V. BAER. Eyes none. Fasciculi of setæ ventral. Rings slightly distinct.

Sp. *Chætogaster limnæi* V. BAER, *Nov. Act. Acad. Cæs. L. C. Nat. Curios.* Vol. XIII. Pl. 2, pp. 611—615, Tab. XXIX. fig. 23; DUGÈS *Ann. des Sc. nat.* sec. Sér. VIII. *Zool.* Pl. 1, f. 24.

*Æolosoma* EHRENB. Eyes none. Body distinctly articulate; lateral fasciculi of setæ in each joint. Mouth anterior inferior surmounted by a lip dilated, produced.

Sp. *Æolosoma Hemprichii* EHRENB. *Symb. phys. Phytozoa*, Tab. V. fig. 2.

*Pristina* EHRENB. Eyes none. Upper lip produced into a soft bearded proboscis. Setæ lateral.

Sp. *Pristina longiseta* EHRENB. *Symb. physic. evertebr.* Dec. I. &c.

*Naïs* MUELL. (exclus. sev. spec.) Eyes two. Setæ lateral, long: fasciculi of short setæ on the belly.

Sub-gen. *Stylaria* LAM. Proboscis frontal, styliform, soft.

Sp. *Naïs proboscidea, Nereis lacustris* L., TREMBLEY *Mém. sur les Polyps*, Pl. 6, fig. 1, (*Millepied à dard*); ROES. *Ins.* III. Tab. 78, figs. 15 *a*, 16, 17, 18, *g*, *h*, *i*, *k*; Tab. 79, fig. 1; MUELLER *Naturgesch. einiger Wurmarten*, s. 14—73, Tab. 1; GRUITHUISEN *Nov. Act. Acad. Leop. Car. Natur. Curios.* Tom. XI. pp. 233—248, Tab. XXXV.

Sub-gen. *Naïs* LAM. Proboscis none.

Sp. *Naïs serpentina* GMEL., ROES. *Ins.* III. Tab. XCII.; MUELLER *Naturgesch. einiger Wurmarten*, s. 84, Tab. IV. &c.

On the propagation of *Naïs* see R. LEUCKART *Ungeschlechtliche Vermehrung bei Naïs proboscidea, Archiv für Naturgesch.* 1851. SCHULTZE on the same subject, *ibid.* 1852, s. 3—7.

The genera noted above form a small natural group of worms, for the most part living in fresh-water, the *Naïdina* of EHRENBERG. Comp. on these and some other genera P. GERVAIS, *Note sur la disposition systématique des Annélides chétopodes de la famille de Naïs, Bullet. de l'Acad. r. de Bruxelles*, Tom. V. no. 1; O. SCHMIDT *Beiträge zur Anat. u. Physiol. der Naïden;* MUELLER'S *Archiv.* 1846, s. 406, &c. Besides the propagation by eggs, these animals are also multiplied by spontaneous division. The most complete observations on this point relate to *Naïs proboscidea.* In the last joint of a simple Naïs (which MUELLER calls *Jung-fer Naïd, Virgin Naïs*) a young Naïs with eye-spots is gradually developed; it grows and remains connected with the mother: sometimes on this a second or

third daughter is found to be developed, which always arises more forward (the last is the oldest, that which first came into being), and ordinarily the first daughter already possesses the rudiment of a little daughter before she separates herself; the vessels, the intestinal canal, the nervous cord run uninterruptedly through these united animals; at length the united or compound animal is broken, and the eldest daughter (herself already a mother) separates herself, after the mother-naïs has made frequent strokes to and fro with her tail. On the eggs of the *Naïdæ* see DUGÈS *Ann. des Sc. nat.* XV. pp. 322—324. Six or seven eggs are enclosed in a common capsule, a grey-coloured vesicle of $\frac{3}{4}$ line in diameter.

[From later observations, as those of LEUCKART and SCHULTZE referred to above, the process of non-sexual multiplication does not appear to be quite so simple as here described. The first and all-important step is the development of a bud between two rings nearly in the middle of the length of the body; so that this now consists of three portions, the anterior, the posterior, and the intervening bud. All the three become distinct individuals, the first, by developing its tail, the last its head, and the bud the head-segments and anal portion in the same order of succession as in development from the egg. Previous to the separation of these three worms a new bud is usually formed in front of the middle worm, and in front of it a third bud, &c., so that sometimes a chain of many connected individuals is met with which all receive nutriment (introduced by the mouth of the anterior member of the chain) from the intestinal canal common to them all. This process appears to have been observed in other families also (*Amphitritæ*, *Nereidæ*), but would seem in all to be limited to the period preceding the sexual development.]

*Enchytræus* HENLE. Mouth inferior, sub-terminal. Sexual orifice in the eleventh ring of the body. Four fasciculi of usually three setæ short and uncinate in each ring. Body round, anteriorly acuminate, posteriorly truncated.

Sp. *Enchytræus albidus* HENLE, MUELLER'S *Archiv.* 1837, s. 74—90, Tab. VI; a white worm two to six lines long, it lives in the earth and is especially found in flower-pots.

*Tubifex* LAM., *Tubilumbricus* BLAINV. Body filiform, transparent, doubly aculeate, attenuated at both ends, inclosed in a tube composed of particles of mud and open at both ends.

Sp. *Tubifex rivulorum, Lumbricus tubifex* MUELL.; TREMBLEY *Polypes*, Pl. 7; fig. 2; *Encyclop. méth., Vers.* Pl. 34, figs. 4—7; MUELL. *Zool. dan.* Tab. 84, figs. 1, 2. This reddish little worm lives at the bottom of ponds and becks; by the union of many accumulated worms of this species red spots are caused at the bottom of the water, which, on being touched, immediately vanish, for the worms hide themselves in the ground.

*Sœnuris* HOFFMEISTER. Upper lip exsert, spoon-shaped. Clitellum little, distinct. Four fasciculi of five to eight setæ in each ring.

Comp. HOFFMEISTER *Des vermibus quibusdam ad genus Lumbricorum pertinentibus*, 4to. Berolini, 1842.

*Lumbriculus* GRUBE. Body round, with four rows of double aciculæ. Mouth inferior; a lobule resembling an upper lip, not distinct from the following segment. Cingulum none. Segments of the body numerous.

Sp. *Lumbriculus variegatus* (*Lumbricus variegatus* MUELL.?) GRUBE in ERICHSON'S *Archiv f. naturgesch.* 1844, s. 200—207, Taf. VII. fig. 2; about two inches in length; through the transparent skin the motions of the dorsal vessel full of red blood, and of its blind digitiform lateral appendages which contract and expand in every segment, may be seen.

Sub-genus *Euaxes* GRUBE (*Rhynchelmis* HOFFM.). First segment (head) elongate, sometimes produced into a long thread.

Sp. *Euaxes filirostris* GRUBE, ERICHSON'S *Archiv.* 1844, pp. 204—207, Taf. VII. fig. 1, in fresh-water like the former; 3¼ inches long. *Euaxes obtusirostris* MENGE, ERICHSON'S *Archiv.* 1845, Taf. III. fig. 1.

*Lumbricus* L. (exclusive of species). *Enterion* and *Hypogæon* SAV. Body cylindraceous, attenuated at both extremities, obtuse posteriorly. Mouth sub-terminal, under the exsert upper lip. Setæ not retractile, disposed in longitudinal rows. Clitellum or cingulum, *i. e.* a tumid fleshy glandular zone mostly composed of a various number of rings in the anterior part of the body (saddle or girdle).

Of this genus there are different species in Europe which were formerly confounded under the name of *Lumbricus terrestris*. See SAVIGNY *Analyse d'un Mém. sur les Lombrics, Comptes rendus des travaux de l'Institut.* 1820; DUGÈS *Ann. des Sc. nat.* XV. 1828, pp. 289—294, *ibid.* sec. sér. *Zool.* VIII. 1837, pp. 18—25; FITZINGER, in OKEN'S *Isis*, 1833, pp. 549—553; HOFFMEISTER *Diss. de Vermibus quibusdam ad genus lumbricorum pertinentibus.* Berolini, 1842, (ERICHSON'S *Archiv f. Naturgesch.* 1843, p. 183); the same: *Die*

*bekannte arten aus der Familie der Regenwürmer, mit Zeichnungen nach dem Leben.* Braunschweig, 1845, 4to.

On the anatomy compare MONTÈGRE *Observations sur les Lombrics ou vers de terre, Mém. du Museum,* I. 1815, pp. 242—248, Pl. 12; J. LEO *De structurâ Lumbrici terrestris,* Regiomonti, 1820, 4to, *cum Tab. æn.;* C. F. A. MORREN *Commentatio de structura anatomica et historia naturali Lumbrici vulgaris sive terrestris* (*Annal. Acad. Gandavensis*), Gandavi, 1829, *cum tabulis, &c.*

The setæ are short and rigid, in every ring 8, on each side two pairs, so that eight rows run longitudinally on the body, four laterally, and four beneath; in *Hypogæon* SAV. there is moreover another row of single hairs in the middle of the back. The intestinal canal is straight, with a membraneous pyriform *proventriculus* and a round or spherical muscular stomach; behind the stomach it is divided by many transverse folds into blind pouches, which further back are less developed, where also the intestinal canal becomes smaller though on the whole it is wide throughout. In the interior of the canal on the dorsal side is a band, which begins a little behind the stomach, at this anterior end, as also at the posterior, runs to a point, and consists of two membranes, of which the external is yellow, the internal white; *intestinum in intestino* WILLIS, *typhlosole* MORREN. This enigmatical part is probably a duplication of the membrane of the intestine, an internal *mesentery* (MORREN); it may be compared with the valvular membrane of certain sharks[1]. To the sexual organs belong in the first place three pairs of grey-yellow saccules which are situated in the anterior part of the body (in the common large earth-worm, *Lumbricus agricola* HOFFMEISTER, in the eleventh, twelfth, and thirteenth ring), and of which the posterior pair is the largest. These parts are usually considered to be ovaries, but STEENSTRUP, who here also denies Hermaphroditism, supposes them to be *testes* in which the seed is formed with the *spermatozoa* in cells, that may be readily mistaken for eggs. H. MECKEL maintains that these organs are in all individuals *testes*, and says, that the *ovaria*, intimately conjoined with them, lie like a brown-yellow lobe on each of these saccules. Four small vesicles, resembling barley-corns, placed more laterally (two on each side), contain in the pairing season a white fluid with *spermatozoa* free and developed: by most writers they have been signalised as the

[1] Perhaps also it is furnished with a vessel (*Vena mesenterica interior*); see DUVERNOY in the second edition of CUVIER, *Leç. d'Anat. comp.* Tom. V. 1817, p. 335.

*testes;* STEENSTRUP on the contrary thinks that they ought not to be considered to be the parts where the seed is formed, but where it is collected (as seminal vesicles in the male subject, as *bursæ copulatrices* in the female). The efferent ducts of these vesicles open externally, according to SAVIGNY; but later writers have failed to discover the openings; rather are they in connexion with the efferent ducts of the yellow saccules; these ducts fall at length into a common canal on each side backwards and end with two openings at the fifteenth or sixteenth ring of the body. At the origin of these two canals lie two small irregular saccules, covered by a thin and glistening membrane, which according to DUGÈS and STEENSTRUP are filled with many convolutions of the efferent canal and form the passage of the yellow saccules to the straight part of the canal which runs backwards[1]. Earth-worms are oviparous, not viviparous; they pair during the whole Summer, especially by night, when they creep from the earth; but how impregnation is effected, is not yet sufficiently explained, since the apertures of the sexual organs are not brought immediately together. The anterior portions of the two worms lie next each other, but with the heads in opposite directions (see in MORREN l. l. Tab. XXVII). Thus the part named by WILLIS *Clitellum* (saddle) in each of the two worms lies towards the place where the sexual openings of the other worm are found. This *clitellum* is a round swelling of the body which occupies from six to nine rings (in *Lumbricus agricola* from the 29th to the 36th or from the 31st to the 38th ring), and which during the time of copulation is more strongly developed, and in young individuals is entirely wanting.

Sp. *Lumbricus agricola* HOFFM., *Lumbricus terrestris* L. (in part), HOFFMEISTER *Die bekannte Arten aus der Fam. der Regenw.* fig. 1; the largest species in northern Europe, from eight inches to more than a foot in length.

Family V. *Maldanicæ* SAV. Branchiæ none. Mouth bilabiate, inferior. Rudiments of feet provided with setæ; the three anterior pairs without ventral pinna, the rest with a transverse tubercle, supplied with uncinate setæ, in place of a ventral pinna.

*Clymene* SAV. Body cylindrical, with few elongate segments,

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[1] The best description and figure of the organs of propagation in *Lumbricus* were given by G. R. TREVIRANUS, *Zeitsch. für Physiol.* v. s. 154—166, Tab. III.; see also STEENSTRUP, *Hermaphroditismus Tilvœrelse*, pp. 35—40, Tab. I. figs. 2—7, and H. MECKEL in MUELLER'S *Archiv.* 1844, s. 480—483.

the posterior extremity infundibuliform with margin usually denticulate. A membraneous tube covered with fragments of shells, open at both ends, including the animal.

Sp. *Clymene amphistoma* SAV. *Descr. de l'Egypte, Annél.* Pl. 1, fig. 1; GUÉRIN, *Iconogr., Annél.* Pl. 10, fig. 1, from the Red Sea. See fig. of other species, CUV. *R. Ani. éd. ill., Annél.* Pl. 22.

*B.* External organs of respiration.

* *Tubulate.*

*Note.*—The *Cephalobranchiate*, or *tubicolous* EDW. *Annulata*, are more imperfect than the roving or notobranchiate. It seems right therefore to introduce them here, although the affinity by which *Arenicola* is connected with the *Lumbricini* points to a different arrangement.

Family VI. *Amphitritæ* SAV. Head not distinct, eyes none, body usually encased in a tube.

*A.* Branchiæ anterior, more or less composite, with one, two or three pairs.

*Siphonostoma* OTTO. Two larger tentacles (branchiæ?) and several soft cirri around the mouth. Fasciculi of setæ in double pairs in every segment; the setæ in the anterior segments extremely long, directed forwards, glistening with gold. The worm not included in a tube.

Sp. *Siphonostoma diplochaitus* OTTO *Nov. Act. Acad. Natur. Curios.* Tom. X. 2, 1821, p. 628, Tab. 51, in the Mediterranean at Naples; other species have been described by MILNE EDWARDS, GRUBE and RATHKE; see RATHKE *Beitr. zur Fauna Norwegens, Nov. Act. Acad. Natur. Curios.* Tom. XX. 1, 1843, pp. 211—219, Tab. XI.

To the same division also appears to belong the worm described by ABILDGARD in the *Zoolog. danic.* Tab. 90, as *Amphitrite plumosa*, but which differs from *Amphitr. plumosa* of O. FABRICIUS (*Fauna grœnl.* p. 288); OKEN formed from it the genus *Pherusa*[1], (*Lehrb. d. Zoolog.* I. s. 377): *Siphonostoma plumosum* RATHKE *Beitr. zur vergl. Anat. u. Physiol.* 1842, p. 84, Tab. VI. figs. 1—7, *Beitr. zur Fauna Norwegens*, p. 208, Tab. XI. f. 1, 2.

[1] The name *Pherusa* was also given by LAMOUROUX to a genus of the class of Polyps, of which the polypary alone is known and to which *Flustra tubulosa* belongs; *Hist. des Polypiers flexibles*, 1816, p. 117; G. JOHNSTON formed from *Amph. plumosa* the genus *Flemingia*, from which his genus *Trophonia* does not differ. *Ann. of Nat. Hist.* XVII. p. 294.

*Note.*—*Chloræma* DUJARD. *Ann. des Sc. nat.* sec. Sér. Tom. XI. 1839, *Zool.* p. 288, Tab. 7, fig. 1, is a species of *Siphonostoma* beset with villi secreting mucus; comp. *Siphon. villosum* RATHKE *Faun. Norweg.* l. l. In *Siphonostoma plumosum* also the blood has a green colour, RATHKE l. l. p. 211.

*Amphitrite* CUV. (in part), *Amphictene* SAV. Mouth surrounded by numerous tentacles, and covered by a denticulate velum. Setæ glistening with gold, in a double row in the anterior segment of the body. Branchiæ on both sides, two in the third and fourth segment of the body, incurved, pectinate. The worm included in a thin oblongo-conical tube made of sand cemented together by gelatinous substance.

Sp. *Amphitrite auricoma, Sabella granulata* L., *Pectinaria belgica* LAM.; PALLAS *Misc. Zool.* Tab. IX. figs. 3—5; RATHKE, *Beitr. z. vergl. Anat. u. Physiol.* Tab. V.: these worms, whose tube is known by fishermen under the name of *Sand-quiver*, is met with on our coast. *Amph. ægyptia* SAV. *Descrip. de l'Egypte, Annél.* Pl. 1, fig. 4, GUÉRIN *Iconogr., Annél.* Pl. 2, figs. 3, &c.

*Terebella* CUV. (spec. of genus *Terebella* GM.) Mouth bilabiate, transverse; upper lip produced, surrounded by numerous long tentacles. Rudiments of feet with a double row of uncinate setæ at the ventral pinna, except the first pair. Branchiæ ramose in the anterior segments, which are without rudiments of feet. The worm included in a tube composed of sand and fragments of shell cemented together.

Sp. *Terebella conchilega, Nereis conchilega* PALL., *Misc. Zool.* pp. 131—138, Tab. IX. figs. 14—22; very common on our coast, where whole heaps of the cases or houses (generally empty) of these animals are met with. *Terebella medusa* SAV., GUÉRIN *Iconogr., Annél.* Pl. 2, figs. 2, &c.

*Terebellides* SARS. Four pectinate branchiæ.

Sp. *Terebellides Strœmii* SARS, *Beskrivelser og Jagttagelser over nye i Havet ved den Bergenske kyst levende Dyr.* 1835, Tab. 13, fig. 31.

*Sabella* CUV., SAV., *Amphitrite* LAM. (sp. of *Sabella* L.) Mouth transverse, not tentaculated, situated amongst the branchiæ. Branchiæ two flabellate, infundibuliform or pectinate, spiral, large, with bearded laciniæ and a soft cylindrical filament at the base in the first segment of the body, which is without rudiments of feet. The anterior pediform tubercles with uncinate setæ at the ventral pinna, with a fasciculus of subulate setæ at the dorsal pinna; the posterior

tubercles supplied with uncinate setæ at the dorsal pinna, with a fasciculus of subulate setæ at the ventral pinna. The worm included in a gelatinous tube covered with sand.

Sp. *Sabella pavonina* SAV.; *Amphitrite penicillus* LAM., BASTER *Natuurk. Uitsp.* I. p. 88, Tab. IX. fig. 1; *Tubularia penicillus, Zool. dan.* Tab. 89, figs. 1, 2, in the North Sea; *Sabella magnifica* SAV.; *Tubularia magnifica* SHAW *Linn. Transact.* V. p. 228, Tab. IX.; *Sabella (amphitrite) taurica* RATHKE *Fauna der Krym, Mém. des Sav. étrangers de l'Acad. imp. de Saint-Petersb.* Tom. III. 1837, p. 426, Tab. VIII. figs. 8—15, &c.

*Serpula* L. Mouth situated between the branchiæ, not tentaculate, transverse. Branchiæ two, large, pectinate, flabellate, with bearded laciniæ and a cylindrical filament at the base of different length in each branchia, the longer sustaining an orbicular disc or infundibuliform opereulum. Feet as in the preceding genus. Calcareous tube procumbent, twisted or convoluted into a spire, including the animal.

Sp. *Serpula contortuplicata* L., GUÉRIN *Iconogr., Annél.* Pl. I, fig. 1, (the animal); ELLIS *Corallines*, Tab. 38, fig. 2; *Serpula vermicularis* L., *Zool. danic.* Tab. 86, figs. 7—9, &c.

Comp. on this genus, which is somewhat differently determined and into which *Sabella protula* CUV. is also brought, A. PHILIPPI in ERICHSON'S *Archiv.* 1844, s. 186—198.

*Spirorbis* LAM.

Sp. *Serpula spirorbis, Spirorbis nautiloïdes* LAM., *Zool. danic.* Tab. 86, figs. 1—6; GUÉRIN *Iconogr., Annél.* Pl. I. fig. 6.

*B.* Branchiæ dorsal numerous.

*Hermella* SAV. (*Amphitrite* CUV. in part), *Sabellaria* LAM. First segment of the body supplied on both sides with a triple series of very glistering tufts, the external very patent, the internal close. The rudiments of the feet, in addition to setæ, supplied with a cirrus elongate, adhering above to the base, performing the office of branchiæ. Animals living gregariously, included in tubules made of sand and fragments of shells, conjoined to form a common honey-combed mass.

Sp. *Hermella alveolata, Sabella alveolata* L., ELLIS *Corallines*, Tab. XXXVI.; on the English and French coasts. Formerly the bundles of threads beneath the first segment were supposed to be gills. MILNE EDWARDS was the first who indicated the true gills, on account of which this animal belongs to the

*Annélides dorsibranches* of CUVIER, whilst, however, in a natural arrangement it might better remain with the *Amphitritæ*, *Ann. des Sc. nat.* sec. Sér. x. *Zool.* p. 208.

** *Naked, roving.*

(Commonly *Notobranchiate*, *Dorsibranches* CUV.)

Family VII. *Arenicolæ* (*Telethusæ* SAV.) Rudiments of feet of a dorsal fasciculus of setæ and a ventral transverse tubercle with setæ very minute, plane, incurved. Branchiæ arborescent in the middle of the body, with a double row at the sides of fasciculi of dorsal setæ. Head not distinct; eyes and jaws none.

*Arenicola* LAM. Body elongate, with segments subdivided by transverse folds, incrassated forwards, becoming smaller backwards, without setæ or other appendages behind the last pair of branchiæ. Mouth terminal supplied with a proboscis retractile, papillose.

Sp. *Arenicola piscatorum*, *Lumbricus marinus* L., *Nereis lumbricoïdes*, PALLAS *Nov. Act. Petrop.* II. 1788, p. 223, Tab. V. f. 19, 19*; HOME *Phil. Transact.* 1817, Pt. I. Tab. 3; OKEN, *Isis*, 1817, p. 469, with fig.; AUDOUIN and MILNE EDWARDS, *Ann. des Sc. nat.* Tom. 30, 1833, Pl. 22, fig. 8. This species has thirteen pairs of gills. It lives in deep canals excavated in the sea-sand, which the worm forms with its head, whilst the sand is swallowed and passed through the intestinal canal; this worm is flesh-coloured, sometimes blackish (*Arenicola carbonaria* LEACH), and exudes a yellow fluid on being touched. Fishermen use it as bait to catch shell-fish with the hook. *Arenicola branchialis* AUD. and EDW. l. l. fig. 13, has nineteen or twenty pairs of gills, and is smaller than the former. *Arenicola Bœckii* RATHKE, *Fauna Norwegens*, p. 181, Tab. VIII. f. 19—22, differs from the former species by the much more numerous gills and by the rings, which lie behind the last pair of gills, possessing bundles of hairs; also the anterior part of the body is not incrassated like the former species. It seems, therefore, that this species should form a sub-genus.

It seems that the genus *Scalibregma* RATHKE ought to be added to the Arenicolæ: it has four pairs of arborescent branchiæ (in the fourth, fifth, sixth and seventh segment) with a proboscis not warty; l. l. p. 182, Tab. IX. figs. 15—21.

Family VIII. *Chætopterina.* Anterior and posterior rudiments of feet with a fasciculus of dorsal setæ, without uncinate setæ, the middle feet with a dorsal appendage, membraneous, large (branchial?). Head not distinct; maxillæ none.

*Chætopterus* CUV. (Worm elongate, included in a coriaceous tube).

Sp. *Chætopterus pergamentaceus* Cuv., Milne Edwards *Ann. des Sc. nat.* Tom. xxx. Pl. 22, fig. 1, Cuv. *R. Ani. éd. ill., Annél.* Pl. 20, fig. 2; in the West Indian Sea. A species of this genus occurs also in the Mediterranean.

Family IX. *Peripatina.* The rudiments of feet are conical tubercles, supplied with a fasciculus of thinly set setæ at the point. Head distinct, provided with two cirri (antennæ) annulate, large, a short proboscis, and two jaws.

*Peripatus* Lansdown Guilding. Body with few segments subdivided by annulate folds, obtuse at both extremities, gibbous above, plane beneath.

Sp. *Peripatus iuliformis* Lansdown Guilding, *Zool. Journal*, II. Pl. xiv. fig. 1; Audouin and Milne Edw. *Ann. des Sc. nat.* Tom. xxx. pp. 412—414, Pl. 22, figs. 5—7; West Indies. This animal would seem, according to some, to be a *myriapod* insect; the English author who first made it known, considered it to be a mollusc. Milne Edwards, on anatomical grounds, defends its reception into this class; *Ann. des Sc. nat.* sec. Sér. xviii. *Zoolog.* pp. 126—128. *Branchiæ* are not present, if the conical rudiments of feet are not to be considered as respiratory organs.

Family X. *Ariciæ.* Body cylindrical, attenuated at both extremities, with head little distinct. Proboscis short, without jaws. Rudiments of feet with cirrus usually single; branchiæ either none distinct or resembling cirri or lobes adhering to the base of the feet.

This small group, regarded by Audouin and Milne Edwards as a distinct family, contains imperfect ringed worms, which in part belong to the Nereids of former writers. Where no special gills are present, the *cirri* appear to serve for respiration.

*Cirratulus* Lam. Body elongate, round, with few dorsal and ventral setæ remote, and long dorsal cirri. The branchiæ very long cirri in the anterior part of the body.

Sp. *Cirratulus borealis, Lumbricus cirratus* Muell., O. Fabricii *Fauna grœnl.* pp. 281—283, fig. 5, *Encyclop. méth., Vers.* Pl. 34, figs. 10—12; *Cirrat. Lamarckii* Aud. and Edw. *Ann. des Sc. nat.* xxvii. Pl. xv. figs. 1—4, xxix. pp. 410, 411; Grube *Kiemenwürmer*, 1838, pp. 32, 33.

*Ammotrypana* Rathke (*Beitr. z. Fauna Norweg.*) A genus related to the preceding: it differs by defect of the long cirri (branchiæ) in the anterior part of the body.

Sp. *Ammotrypana aulogaster* Rathke, l. l. p. 188, Tab. x. figs. 1—3, &c.

*Ophelia* Sav. Comp. Edw. and Aud. *Ann. des Sc. nat.* xxix. pp. 403—407. According to Sars the animal is so described that

the dorsal surface is taken for the ventral, the anterior part for the posterior; the author, *Ann. des Sc. nat.* sec. sér. VII. *Zoologie*, p. 247, counts it amongst the Nereids.

*Aonis* SAV.

Comp. AUD. and Edw. *Ann. des Sc. nat.* Tom. XXVII. pp. 400—403, Pl. XVIII. figs. 9—13.

*Aricia* SAV. Body elongate, attenuated at both ends, with conical head. The ventral oar of the anterior feet with a transverse incised crest, of the posterior with a conical setiferous tubercle and small cirrus, with soft branchial appendage. Dorsal cirri triangular, plane.

Sp. *Aricia Cuvierii* AUD. and EDW. *Ann. des Sc. nat.* XXIX. p. 397, XXVII. Pl. 15, f. 5—13, &c.

*Scoloplos* BLAINV.

Comp. OERSTED *Grönl. Annul. dorsibr.* p. 199. Here also seems to belong the genus *Travisia* JOHNSTON, *Ann. of Nat. Hist.* IV. p. 373, Pl. XI. f. 11—18.

*Spio* O. FABR. Head with two very long antenniform tentacles. Mouth inferior or subterminal, little exsertile and without jaws. Body elongate, slender. Superior pinna with uncinate or capillary setæ, inferior with capillary setæ; branchiæ ligulate, dorsal, in the anterior part of the body very large, in the posterior evanescent.

Sp. *Spio seticornis* O. FABR., BASTER *Nat. Uitsp.* II. pp. 149, 150, Tab. XII. fig. 2.

O. FABRICIUS, *von dem Spio-Geschlecht, Schriften der Berliner Gesellsch. naturf. Freunde* VI. p. 256. RATHKE, *Beitr. zur Fauna der Krym*, Tab. VIII. figs. 1—6, p. 421 (*Spio lævicornis*), OERSTED *Grœnl. Annul.* pp. 202, 203.

The genus *Malacoceros* QUATREFAGES is distinguished by the defect of eyes, GUÉRIN, *Magas. de Zool.* 1843.

Family XI. *Nereidæ*. Body elongate, slender, with head distinct, supplied with tentacles (antennæ) and eyes. Rudiments of feet similar throughout the whole body. Branchiæ not distinct from the feet or small appendages of the feet, like lobes or tubercles. Proboscis large, often armed with two horny jaws.

*Goniada* AUD. and EDW. Head conical; with pinnæ of segments remote, each of them supplied with an acus and setæ with conical lobes or cirri. Proboscis large, furnished beneath with a double row

of horny denticles, without maxillæ or armed at the point with two maxillæ.

Sp. *Goniada emerita* AUD. and EDW., *Ann. des Sc. nat.* XXIX. Pl. 13, figs. 1—4.

*Ephesia* RATHKE. Head conical; with dorsal pinnæ of the segments mammillate, setiferous, the ventral supplied with a fasciculus of short setæ. Proboscis large, clavate, smooth.

Sp. *Ephesia gracilis* RATHKE, *Beitr. zur Fauna Norwegens*, pp. 174—176, Tab. VII. figs. 5—8.

*Glycera* SAV. Head conical, at the extremity with four tentacles small, subulate, arranged in a cross. Dorsal and ventral pinnæ approximate, inserted in a common tubercle, supplied with acus and a fasciculus of few setæ. Cirrus at the base of each pinna; branchial appendage simple or bifid in every segment, except only the anterior and posterior. Proboscis large, usually with four jaws.

Sp. *Glycera Meckelii* AUD. and EDW., *Ann. des Sc. nat.* XXIX. p. 263, XXVII. Pl. XIV. figs. 1—4; *Glycera alba, Nereis alba* MUELLER, *Zool. dan.* Tab. LXII. fig. 6. (Comp. JOHNSTON, *Ann. of Nat. Hist.* XV. p. 148, RATHKE, *Beitr. zur Fauna Norweg.* p. 173.)

*Pollicita* JOHNSTON (*Bebryce* THOMPSON). Comp. *Ann. of Nat. Hist.* XVI. pp. 4—6.

*Nephthys* CUV. Head truncated anteriorly, supplied with four small tentacles. Dorsal and ventral pinnæ remote, setiferous, increased by a membraneous lobe. Branchiæ ligulate at the dorsal pinnæ. Proboscis large, furnished with conical tentacles and two maxillæ not exsert. Body linear, elongate, with terminal style.

Sp. *Nephthys Hombergii* CUV., AUD. and EDW., *Ann. des Sc. nat.* XXIX. Pl. XVII. figs. 1—6, CUV. *R. Ani. éd. ill., Annél.* Pl. XV. fig. 2; *Neph. longisetosa* OERST. *Grœnl. Annul.* p. 195, Tab. VI. figs. 75, 76, (perhaps the same as *Nepth. ciliata* RATHKE, *Beitr. z. Fauna Norwegens*, p. 170).

*Phyllodoce* SAV. (RANZANI). Head small, supplied with two eyes, and four or five tentacles, the fifth unequal, very small, remote. Tentacular cirri in the anterior segments. Setigerous tubercles undivided, with dorsal and ventral appendage lamellose, branchial. Body terminated by two styles. Proboscis thick with small tentacles at the orifice, without jaws.

Sp. *Phyllodoce laminosa* SAV., AUD. and EDW. *Ann. des Sc. nat.* XXIX. p. 244, Pl. 16, figs. 1—8; *Phyllod. clavigera, Nereis viridis* MUELL., *Eulalia?* SAV.,

AUD. and EDW. l. l. p. 248, Pl. 16, figs. 9—13; *Phyllod. saxicola* QUATREFAGES, GUÉRIN *Magas. de Zool.* 1843, *Annél.* p. 1, Pl. 1, &c.

*Psamathe* JOHNST.

*Ioïda* JOHNST.

Comp. JOHNSTON, *Ann. of Nat. Hist.* IV. pp. 229—231.

*Myriana* SAV.

*Alciopa* AUD. and EDW. Eyes large, lateral. Tubercles lobate (glandular) at the base of the pediform tubercles. Other characters as in *Phyllodoce.*

Sp. *Alc. Reynaudii* AUD. and EDW. *Ann. des Sc. nat.* XXIX. pp. 236—238, Tab. XV. figs. 6—11; Comp. A. KROHN, *Zool. und anat. Bemerkungen ueber die Alciopen,* ERICHSON'S *Archiv.* 1845, s. 171—184, Tab. VI. Besides the description of some new species this memoir contains also anatomical details, amongst which, especially those upon the eyes are worthy of notice (see above, p. 217). The glandular appendages of the rudimentary feet AUDOUIN and MILNE EDWARDS consider to be gills.

*Hesione* SAV. Head broad, truncated, furnished with four lateral eyes and four small tentacles. Long tentacular cirri at the sides of the head. Setigerous tubercles of the segments undivided, with dorsal and ventral cirrus filiform, the dorsal long. Body oblong, with segments not numerous. Proboscis large, without jaws.

Sp. *Hesione splendida* SAV. *Descr. de l'Égypte, Annél.* Pl. III. fig. 3, GUÉR. *Iconogr. Annél.* Pl. 8, fig. 3.

*Note.*—Genus *Halimede* RATHKE is distinguished from *Hesione* by three branchiæ (lobed appendages) at each of the pediform tubercles (*Beitr. z. Fauna Norw.* pp. 166—169).

*Syllis* SAV. Head bilobed, anteriorly emarginate, with four eyes placed in transverse row, and three tentacles, thin, moniliform. Setigerous tubercles of the segments undivided, with dorsal cirrus long, moniliform. Proboscis without jaws. Body elongate, slender, with numerous segments.

Sp. *Syllis monilaris* SAV. *Descr. de l'Égypte, Annél.* Pl. IV. fig. 3, GUÉR. *Iconogr. Annél.* Pl. 8, fig. 1; *Syll. Maculosa* EDW., CUV. *R. Ani. éd. ill., Annél.* Pl. 15, figs. 1, &c.

*Nereis* CUV. (spec. of gen. *Nereis* L., *Lycoris* SAV. and *Lycastis* SAV.) Head anteriorly attenuated, with four eyes arranged in two series and four short tentacles, the external larger, conical. Subulate

tentacular cirri at the base of the head in the first segment of the body; two cirri in each segment. Proboscis thick, cylindrical, armed with two horny exserted jaws. Body elongate, with numerous segments.

*A.* The dorsal pinna of the feet confluent with the ventral or not distinct, without branchial appendages. *Lycastis* SAV., AUD. and EDW.

*B.* The dorsal pinna distinct from the ventral, with aciculus and bundle of setæ at the extremity of each, and appendages or laciniæ supplying the office of gills. *Lycoris* SAV., *Nereis* of Authors.

Sp. *Nereis nuntia, Lycor. nuntia* SAV. *Descr. de l'Égypte, Annél.* Pl. IV. fig. 3, GUÉRIN *Iconogr., Annél.* Pl. 7, from the Red Sea; *Nereis pelagica* L., BASTER *Natuurk. Uitsp.* II. Tab. VI. fig. 6, OERSTED *Grœnl. Annul.* p. 175, Tab. IV. figs. 53, &c.

*Heteronereis* OERST.

Sp. *Heteronereis arctica* OERST. l. l. Tab. IV. fig. 51; *Nereis grandifolia* RATHKE, *Beitr. z. Fauna Norwegens,* pp. 155, &c.

Family XII. *Eunicecæ.* Body elongate, with numerous segments. Rudiments of feet supplied with a single pinna, a terminal setiferous tubercle, and two cirri. Proboscis armed with seven, eight or nine horny jaws. Branchiæ in some none (cirri supplying the office of branchiæ), in others above the dorsal cirrus adhering to many segments of the body, pectinate.

*A.* Branchiæ not distinct from the cirri.

* Head covered by the first segment of the body. Jaws nine.

Genera *Aglaura* SAV., *Œnone* SAV.

Comp. GUÉRIN *Iconogr. Annél.* Pl. 6.

** Head not covered by the first segment of the body.

*Lumbrineris* BLAIN., AUD. and EDW. Head obtusely conical, with tentacles either none or two inserted into small tubercles at the posterior margin. Jaws eight.

Sp. *Lumbrineris d'Orbygnii* AUD. and EDW. *Ann. des Sc. nat.* Tom. XXVII. Pl. 12, figs. 9—12; *Lumbrineris pectinifera* QUATREF., GUÉR. *Magas. de Zool.* 1843, *Annél.* pp. 6—8, Pl. II. figs. 3—8, &c.

*Lysidice* SAV. Head broad, small, with three short tentacles. Jaws seven.

Comp. AUD. and EDW. *Ann. des Sc. nat.* XVIII. pp. 233—237, Tom. XXVII. figs. 1—8.

*B.* Branchiæ distinct. Jaws seven.

*Diopatra* AUD. and EDW. Head small, with nine tentacles. Filaments of branchiæ numerous, placed on a petiole twisted spirally.

Sp. *Diopatra amboinensis* AUD. and EDW. *Ann. des Sc. nat.* XXVIII. pp. 229, 230, Pl. X. figs. 6—8.

*Onuphis* AUD. and EDW. Head small, furnished with seven tentacles. The first two pairs of pinnæ larger, directed forwards. Branchiæ in every segment, except the first two, the anterior of a simple filament, the posterior pectinate.

Sp. *Onuphris eremita* AUD. and EDW. *Ann. des Sc. nat.* XXVIII. pp. 226, 227, Pl. X. figs. 1—5; *Onuphris Eschrichtii* OERST. *Grœnl. Annul.* p. 172, Tab. III. figs. 33—41, fig. 45. These worms live in cases; they are sometimes covered with bits of shell, like that of *Terebella*, as in the last-named species, from which I suspect that *Onuphris conchilega* SARS, *Beskrivelser*, 1835, pp. 61—63, Pl. X. fig. 28, does not differ.

*Eunice* CUV., AUD. and EDW. (*Leodice* SAV.) Head distinct, round or lobate, with five tentacles. Pectinate branchiæ above the dorsal cirrus in most of the segments, or in the anterior part of the body.

Sp. *Eunice gigantea, Nereis aphroditois*, PALL. *Nov. Act. Petropol.* Tom. II. pp. 229, 230, Tab. V. figs. 1—7, CUV. *R. Ani. éd. ill., Annél.* Pl. 10; this species becomes more than four feet long:—*Eunice sanguinea, Nereis sanguinea* MONTAGU *Trans. of Linn. Soc.* Tom. XI. pp. 20, 21, Tab. 3, figs. 1—3; *Eunice antennata* SAV., *Descrip. de l'Égypte, Annél.* Pl. V. fig. 1, GUÉRIN, *Iconogr., Annél.* Pl. V. figs. 1, &c.

Family XIII. *Amphinomaceæ.* Body depressed, oblong. Head furnished with two or four eyes and mostly five tentacles. The pediform tubercles supplied with setæ only, not with aciculæ. Branchiæ arborescent or fasciculate in all the segments of the body, the three or four anterior excepted, placed at the sides of the back. Proboscis without jaws.

*Amphinome* BRUGUIÈRE. (Spec. of *Aphrodita* PALL., of *Terebella* GM.)

*A.* Pediform tubercles with undivided pinna and single cirrus. Tentacles five in the head; caruncles behind the base of the middle tentacle none. Branchiæ ramose.

*Hipponoë* Aud. and Edw.

Sp. *Hipponoë Gaudichaudii* Aud. and Edw. *Ann. des Sc. nat.* Tom. xx. 1830, pp. 156—159, Pl. iii. figs. 1—5, Guérin *Iconogr., Annél.* Pl. 4 bis. fig. 3, in New Holland (Port Jackson).

*B.* Pediform tubercles with double pinna, remote, each provided with a cirrus. Caruncles behind the base of the intermediate tentacle at the dorsal surface in the head and anterior part of the body.

*Euphrosyne* Sav. Head with single subulate tentacle, and two eyes. Branchiæ made of many branched appendages, arranged in a row between the dorsal and ventral pinna.

Sp. *Euphrosyne laureata* Sav. *Descr. de l'Égypte, Annél.* Pl. ii. fig. 1, Guérin *Iconogr., Annél.* Pl. 4 bis. figs. 1, &c.

*Amphinome* Aud. and Edw. *Pleione* Sav. Head with five short tentacles, and four eyes. Branchiæ ramose, or fasciculate at the base of the dorsal pinnæ.

Sp. *Amphinome rostrata* Pall. *Misc. Zool.* Tab. viii. figs. 14—18, from the Indian Ocean; *Amphinome caruncula* Pall. fig. 12; comp. A. E. Grube, *De Pleione carunculata Diss. Zoot. cum tab. æn.* Regiomontani, 1837, 8vo.

*Chloeia* Sav. Head supplied with five tentacles and two eyes. Branchiæ like a tripinnatifid leaf, placed on the back, remote from the base of the pinnæ. Two terminal styles at the posterior part of the body.

Sp. *Amphinome capillata, Aphrodita flava* Pall. *Misc. Zool.* Tab. viii. figs. 7—11; Cuv. *R. Ani. éd. ill. Annél.* Pl. 9; in the Indian Ocean, from *Amboyna*, &c. The bundles of *setæ* are yellow, the gills, which nearly resemble leaves of Fern, are purple-coloured.

Family XIV. *Aphroditaceæ.* Body in most depressed, oval. Head supplied with tentacles usually five (2—5) and with four eyes. Dorsal and ventral pinnæ distinct, furnished with acus, a fascicle of setæ and a ventral cirrus. Squamæ (*Elytra* Sav.) in most, in place of cirri, placed on the dorsal pinnæ that alternate with dorsal pinnæ supplied with a cirrus. Proboscis usually armed with four jaws.

*Palmyra* Sav. Dorsal squamæ none.

Sp. *Palmyra aurifera* Sav., Aud. and Edw. *Ann. des Sc. nat.* Tom. xxvii. pp. 445, 446, Pl. x. figs. 1—6, from the island *Mauritius.*

Genus *Spinther* Johnston; is it of this family? Body oval, with back convex, abdomen plane. Head indistinct. Elytra none.

Tubercles of the feet similar in all the segments, supplied with a ventral cirrus only.

Comp. JOHNSTON, *Ann. of Nat. Hist.* XVI. 1845, pp. 8—10, *Spinther oniscoïdes*, Pl. II. figs. 7—14.

*Sigalion* AUD., EDW. Body depressed, elongate, with numerous segments. Dorsal squamæ together with dorsal cirrus in most of the segments; the anterior segments that are without squamæ alternating with squamiferous segments.

Sp. *Sigalion Mathildæ* AUD. and EDW. *Ann. des Sc. nat.* Tom. XXVII. pp. 441—443, Pl. IX. figs. 1—10; *Sigalion boa* JOHNSTON, *Ann. of Nat. Hist.* II. pp. 439—441, Pl. XXIII. figs. 6—15, (probably the same species as *Sigalion Idunæ* RATHKE, *Beitr. zur Fauna Norweg.* pp. 150—155, Tab. IX. figs. 1—8; comp. also *Sigalion Estellæ* GUÉR. *Magas. de Zool.* 1833, *Annél.* Pl. 3).

*Acoëtes* AUD. and EDW. Body elongate, with numerous segments. Branchial tubercles at the base of the pediform tubercles in all of them, dorsal squamæ large, the squamiferous segments, without dorsal cirrus, alternating with segments supplied with dorsal cirrus. A coriaceous tube longer than the body concealing the worm.

Sp. *Acoëtes Pleei* AUD. and EDW. *Ann. des Sc. nat.* XXVII. p. 437, Pl. X. figs. 7—14.

*Polyodontes* RENIERI, AUD. and EDW. (*Phyllodoce* RANZANI). Head small, with three tentacles and two pedunculate eyes. Dorsal cirri in the segments destitute of elytra, which alternate with squamiferous segments; ventral cirri short, subulate in all the segments; distinct branchiæ none. Proboscis with two subulate cirri and warty margin, with four large denticulate jaws.

*Polyodontes Ranzanii, Phyllodoce maxillosa* RANZANI, *Opuscoli scientifici*, Bologna, 1817, Tom. I. pp. 105—109, Tab. IV. figs. 2—9, Mediterranean.

*Polynoë* SAV. Body in some oblong or oval, in others slender, elongate. Head with four eyes set on tubercles, and five, sometimes four, tentacles. Jaws large, horny. Branchiæ and dorsal cirri in pediform tubercles destitute of squama, which alternate with squamiferous feet.

Sp. *Polynoë squamata, Aphrodita squamata* L., BASTER, *Natuurk. Uitsp.* II. Tab. VI. fig. V. PALLAS *Miscell. Zool.* p. 91, Tab. VII. fig. 14; *Polynoë lævis*, AUD. and EDW. *Ann. des Sc. nat.* XXVII. p. 421, Pl. IX. figs. 11—19, GUÉRIN, *Iconogr. Annél.* Pl. 9, figs. 4, &c.

*Aphrodita* L. (exclusive of some species), *Halithea* SAV. Head concealed under squamæ or setæ, furnished with two pedunculate eyes and three tentacles. Jaws small or none. Branchiæ and dorsal cirri in feet destitute of squama, which alternate with squamiferous feet. Body oval, depressed.

* *Dorsal squamæ* naked.

Sp. *Aphrodita hystrix*, *Halithea hystrix* SAV., AUD. and EDW., *Ann. des Sc. nat.* XXVII. Pl. 7, figs. 1—9.

** *Dorsal squamæ* covered by a stratum of *villose setæ*.

Sp. *Aphrodita aculeata* L., BASTER, *Natuurk. Uitsp.* Tab. VI. figs. 1, 2, PALL. *Misc. Zool.* pp. 77, &c. Tab. VII. figs. 1—13; *Physalus* SWAMMERD. *Bibl. nat. Sea-Mouse.* Ordinarily five or six inches long and an inch and a half broad. The hairs on the two sides of the body are glistering, green and red, or playing with all the colours of the rainbow; the back is clothed with a felty covering, that consists of interwoven hairs. When this covering is opened, five nearly circular plates (*squamæ, elytra*) are seen on each side, which partially cover each other, and of which the middlemost are the largest. If two consecutive plates be separated, there are seen on the ring that lies between them, small longitudinal nodes, which are parted by a pit, and are provided outwards and backwards with pectinated appendages as though torn at the margin (the gills). In the Atlantic Ocean, the Mediterranean, &c.

*Note.*—The genus *Sagitta* SLABBER, QUOY and GAIM., whose place is uncertain, seems to approximate closely to the *Annulata*. Body not annulate, elongate, pointed at both extremities, supplied with lateral pinnæ and a terminal truncated pinna; head distinct from the body by a neck, with two eyes, and horny teeth on both sides. All the individuals hermaphrodite.

Comp. A. KROHN *Beobachtungen ueber die Sagitta bipunctata*, Hamburg, 1844, 4to; R. WILMS, *Observationes de Sagitta*, Berolini, 1846, 4to.

# CLASS VIII.

## INSECTS (*INSECTA*)[1].

LINNÆUS united all those invertebrate animals, whose body is divided into rings and which have feet consisting of different joints, into a single class, that of Insects. Together with the class of Ringed-Worms they make up one of the four principal groups into

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[1] There is no class of animals on which more has been written than that of Insects; comp. LATREILLE, who has given a sketch of the history of Entomology (*Mém. du Museum*, VIII. 1822, pp. 461—482, also J. N. EISELT, *Geschichte, Systematik und Litteratur der Insectenkunde*, Leipzig, 1836, 8vo, and J. PERCHERON, *Bibliographie Entomologique*, Paris, 1837, 2 vols. 8vo). As observers deserve to be named especially RÉAUMUR (*Mémoires pour servir à l'Hist. des Insectes*, Paris, 1734—1742, 6 vols. 4to), A. J. ROESEL (*Insecten-Belustigung*, Nürnberg, 1746—1761, 4 vols. 4to, with excellent coloured figures) and C. DE GEER (*Mém pour servir à l'Hist. des Insectes*, Stockholm, 1752—1778, 7 vols. 4to). The anatomy was excellently treated by our great countryman, SWAMMERDAM (*Biblia naturæ*, Leiden, 1737, 2 vols. fol.), and afterwards by P. LYONET (*Traité anatomique de la Chenille qui ronge le bois de Saule*, la Haye, 1762, 4to). In this part also in the present century RAMDOHR, TREVIRANUS, HEROLD, BRANDT, LÉON DUFOUR, STRAUS, DRÜCKHEIM, BLANCHARD, NEWPORT, &c. have published many important investigations. Comp. the Articles, *Insectes*, by AUDOUIN, in the *Dictionnaire classique d'Hist. nat.* Tom. VIII. 1825, pp. 559—579, and *Insecta*, in TODD'S *Cyclopædia of Anat. and Physiol.* II. 1839, pp. 873—994.

As general works, introductions and systematic handbooks, the following, amongst others, may be used with advantage:

J. C. FABRICII, *Philosophia Entomologica*, Hamburgii et Kilonii, 1778, 8vo.

Ejusd. *Entomologia Systematica*, Hafniæ, 1792, IV. Tom. (6 vols.) 8vo; *Index alphabeticus*, in J. C. FABRICII, *Entomol. System.* Hafniæ, 1796, 8vo. *Supplementum Entomol. Systematicæ*, Hafniæ, 1779, 8vo.

P. A. LATREILLE, *Hist. natur des Crustacées et des Insectes* (suite aux Œuvres de BUFFON, par SONNINI), Paris, 1802, 1803, 14 vols. 8vo, avec fig.

Ejusd. *Genera Crustaceorum et Insectorum*, Parisiis et Argentorati, 1806, 1807, IV. Tom. 8vo.

W. KIRBY and W. SPENCE, *Introduction to Entomology*, 5th Edit. London, 1828, 4 vols. 8vo.

H. BURMEISTER, *Handbuch der Entomologie*, 1 Bd., *Algemeine Entomologie*, Mit 16 Steindrücken, 4to. Berlin, 1832, 8vo.

J. O. WESTWOOD, *An Introduction to the modern Classification of Insects*. London, 1840, 2 vols. 8vo (with many woodcuts).

As engravings we may, besides ROESEL, especially notice the figures of the *Iconographie du Règne animal*, by GUÉRIN, and those of the *Dictionn. des Sciences naturelles*, which are also to be found in A. M. C. DUMÉRIL, *Considerations générales sur la Classe des Insectes*, Paris, 1823, 8vo.

which Cuvier, as stated above (p. 33), divided the entire Animal Kingdom. We allude to the Type of Articulate Animals, which may be separated into two divisions. The first division includes articulate animals without jointed feet (*apoda*, the *Annulata*), the other articulate animals with feet (*Condylopoda*). Again, articulate animals with limbs (Insects of LINNÆUS) are divided into three classes, of which the first, immediately to be treated of, retains the name of *Insects;* the two other classes, those of the *Arachnids* and of the *Crustaceans*, comprehend those animals which LINNÆUS considered as wingless Insects.

Insects (in the narrower meaning of modern systematic Zoology) are mostly provided with wings; but the presence of these organs of motion does not constitute the character of the class. That is to be sought for in the head distinct from the trunk, to which two antennæ are attached, and in the Respiration by means of air-canals distributed internally through the body and generally divided into very fine branches. The first of these characters distinguishes the Insects from the Arachnids in which the head and thorax form a single piece, and which have no antennæ, the other distinguishes them from the Crustaceans, whose respiratory organs are gills or other external appendages.

The names *Insecta*, notched animals, and in Greek ἔντομα, have all the same meaning. From the last is derived the word Entomology (Insect-Science).

The species belonging to this class are very numerous: in this respect no other class can be compared with Insects. In treating therefore of this class we must keep within strict limits, that we may not too greatly extend our work in the estimation of those who take less interest in this special part.

We will first describe the external structure of these creatures a little more precisely The body of the six-footed Insects, which make up by far the largest portion of this class, is separated into three parts: *head*, *trunk*, and *abdomen*. On the head, besides the parts about the mouth, the antennæ and eyes are distinguished.

By *Antennæ* are understood moveable jointed threads, which, unconnected with the oral organs, are attached to the head, usually close to the eyes. The number of joints is very different; in Butterflies, for instance, very large, in Beetles, mostly eleven, &c. All insects in the perfect condition or last period of life have two

antennæ. Their relative size is very different. Sometimes as in *Locustæ*, they exceed the length of the body, in others again they are very short and almost concealed beneath the eyes. The form likewise is different: the antennæ are said to be *filiform* when they are thin and of the same thickness throughout: *clavate* when they have a knob at the end formed of thicker joints, as in butterflies (*Papiliones*), &c.

The eyes (*oculi*) are either simple or compound. The simple eyes are named eye-points (*ocelli, stemmata*): they look like smooth shining points placed usually in a triangle behind the larger eyes; they are seen in Bees, Wasps, &c. The larger eyes are composed of numerous six-sided façettes, and are occasionally of such magnitude (as in *Diptera, Libellulæ*), as to meet, the head seeming to consist almost entirely of these two eyes. In some instances the number of façettes is surprisingly great: LEEUWENHOECK counted 8000 in the eye of a fly, STRAUS nearly 8820 in that of a cockchafer[1].

The oral apparatus (*organa cibaria, Trophi*) consist of six principal parts, of which four are in pairs and move transversely, whilst two face each other above and below. Of these last the uppermost is the *upper lip* (*labrum*): it is horny and fixed by a joint transversely to the most anterior part of the head. The part of the head to which the upper lip is fastened is named *head-shield* (*clypeus*, in French *chaperon*). The undermost part, facing the other, is named the under lip (*labium*): it closes the mouth below: is composed of two parts of which the inferior and more rigid is named *chin* (*mentum*), and the superior, generally membraneous, *tongue* (*ligula*). Sometimes the *ligula* has two lateral lobes (*paraglossæ*). The remaining four parts are known as *upper* and *under jaws*. The *upper jaws* (*mandibulæ*) are two, placed immediately beneath the upper lip: they move transversely from within outwards, and are often very hard. The *under jaws* (*maxillæ*) are ordinarily softer: are placed beneath the mandibles, and also move laterally, but are less serviceable for cutting the food small than for holding it in the mouth and conveying it to the gullet to be swallowed. In the *Orthoptera* there is a membraneous valve which is fastened to the maxilla. It is called the *helmet* (*galea*) of the lower jaw.

In addition to these principal parts there are also *feelers* (*palpi*,

[1] See plate XX. of SWAMMERDAM'S *Bijbel der natuur*, where the simple and compound eyes of a bee are figured.

*antennulæ*), jointed threads, attached to the under lip (*palpi labiales, s. posteriores*), and to the under jaw (*palpi maxillares*). The upper jaws in Insects are not provided with palps.

In masticating Insects, as Beetles, Locusts, &c., the parts of the mouth, that have been described, may be best and most readily observed. In those which feed by sucking fluids the structure is in appearance very different; yet even here it may be observed that nature remains true to her plan, and that she has provided the suckers not with different but with modified oral parts. We are indebted to the illustrious SAVIGNY for the knowledge of that plan[1].

The sucking Insects possess oral organs which are named *Tongue*, *Beak*, *Sucker* and *Snout*.

The Butterflies (*Glossata* FABR.) afford an example of what has been called *tongue*, or *spiral tongue* (*lingua, lingua spiralis*). It is a canal, occasionally of great length, composed of two laminæ which are corneous or membraneous, on the inside excavated and round externally. When at rest it is rolled up and concealed between two palps. This was almost the entire amount of what was known of the oral parts of Butterflies. But SAVIGNY pointed out in addition two minute upper jaws, placed at some distance from each other, and little, if at all, adapted for motion or mastication. The upper lip is small and membraneous. The laminæ of the tongue, as LATREILLE[2] had already shewn, are in fact nothing else than greatly elongated and extended lower jaws. Their base is united to the head and upper lip, and bears a palp composed of two or three joints. The two larger palps which include the tongue and conceal it when at rest are seated upon a triangular horny under lip.

The case is similar with the suctorial apparatus of the *Hemiptera*, (*Bugs*, *Cicadæ*, &c.) named beak (*rostrum*). It consists of a horny sheath (*vagina*) in which setæ are contained (*setæ rostelli*), that at first sight appear to be three in number. The two lateral setæ are elongated upper jaws: the hair in the middle is double, and consists of two similarly elongated and united under jaws: the under lip, usually jointed, forms the sheath. In the same way in *Diptera* (*Flies*, &c.) the under lip forms the snout (*proboscis*). In its interior

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[1] J. C. SAVIGNY, *Mémoires sur les Animaux sans vertèbres*, Paris, 1816, 8vo. 1ière fascicule.

[2] LATREILLE, *Histoire naturelle des Crustacées et des Insectes*. An. XII. 8vo. T. II. p. 140.

are setæ, like as in the beak, which form the sucker (*haustellum*). A triangular upper lip covers the basal piece of the beak in *Hemiptera*, as it does that of the snout in *Diptera*.

To the head succeeds the trunk or thorax. This part consists of three pieces, of which each bears a pair of feet. The first ring is named *Prothorax*, the second *Mesothorax*, the third *Metathorax*. In four-winged Insects the anterior wings are placed on the middle piece, the posterior wings on the hinder piece. The wings of *Diptera* are placed on the mesothorax. The inferior surface of the trunk is called breast (*pectus*), on which there is sometimes fixed a pointed elongated appendage, the *breast-bone* (*sternum*). The *shield* (*scutellum*) is a part found on the upper part of the thorax behind (at the mesothorax) stretching between the wings[1].

The feet are attached on the inferior surface of the body: in the hexapod Insects every ring of the thorax carries a pair. Between the *sternum* and *epimeron* is an *articular cavity* (*acetabulum*). The first joint is termed *hip* (*coxa, condylus*); sometimes there is a small and very moveable piece between the *epimeron* and *coxa* (*trochanterium, trochantin* AUDOUIN), but it is usually wanting or has coalesced with the *coxa*. The second joint is termed *Trochanter*, it is very small and mostly annular. Then comes the *thigh* (*femur*), the stoutest, and often also the longest joint of the leg. To it succeeds the *shank* (*tibia*) more slender, and in general flattened laterally. Last is the *foot* (*tarsus*), consisting of many joints placed in a line like the small bones of our fingers. The number of these joints is different in different families; occasionally, in certain coleopterous

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[1] The upper surface of the thorax (*dorsum* of AUDOUIN) may be named *notum*, the under surface *sternum*, and just as the entire thorax is divided into three rings, so also a *pronotum* and *prosternum*, *mesonotum* and *mesosternum*, *metanotum* and *metasternum* may be distinguished. Moreover, each ring of the thorax consists of definite special parts, which, however, are not distinctly seen in every ring, whilst some coalesce with others, or by the greater development of others are suppressed; these parts are a *sternum* on the under surface, on either side an *episternum* as a chief part, and behind this an *epimeron*; and, finally, on the upper four pieces placed behind each other, to which AUDOUIN gives the names of *præscutum, scutum, scutellum* and *post-scutellum*; thus there are properly three *scutella*, but what is usually named *scutellum* is a part of the *mesonotum*; at the sides of the *scutum* the wings are attached. Comp. on this interesting subject AUDOUIN, *Recherches anatomiques sur le thorax des Animaux articulés, Ann. des Sc. nat.* I. 1824, pp. 97—135, 416—432, W. S. MAC-LEAY, *Comp. Anat. of thorax in winged Insects. Zoolog. Journal*, No. 18, or *Ann. des Sc. nat.* XXV. 1832, pp. 95—151, with remarks by AUDOUIN and NEWPORT, TODD'S *Cyclopædia*, II. pp. 911—924.

insects it is not the same in the first two pairs of feet and in the last pair, yet in most Insects the number is five. In some coleopterous insects, the penultimate joint is extremely short, and was in consequence overlooked formerly. The last joint of the foot usually ends with two hooklets, or claws: in addition, its inferior surface is often covered with fine hair, to attach it to small inequalities which even the smoothest objects present. Sometimes these hairs are set on two or three delicate membraneous appendages (*cushions, pulvilli*) which the Insects mould to the surfaces over which they run. In this way flies can move upwards on mirrors, or with head downwards on smooth ceilings, as is seen daily[1].

Besides the feet, wings also are placed on the *thorax* of volant insects: on the meso- and meta-thorax, as stated above, when there are four: when only two, on the meso-thorax. They are set on the dorsal surface, and may be compared with the *elytra* or *squamæ* in *Aphrodita:* with the wings of vertebrate animals (Birds, Bats), which are only modifications of the anterior limbs, they have only similarity of use: they are not modified feet: they exist contemporaneously with feet and are independent of them[2]. Wings are membraneous, arid, usually transparent, composed of two laminæ grown together at the edges; these laminæ are expansions of the skin like the parachute extended between the fingers of Bats and between the ribs of flying Lizards (*Draco*). Canals (improperly named *Veins* or *Nerves*) run between the laminæ, and are more or less numerous, more or less branched. These veins are branches of the air-tubes, which lie between two wide horny semicanals of the upper and under laminæ that compose the wing. In some species the males alone have wings. Bees, Wasps, Butterflies, &c. have four wings. In the *Diptera*, besides the wings there are two parts which may be considered as traces of hind-wings, called *poisers* (*halteres*); they consist of a little button with a pedicle, and are often covered by a membraneous scale (*squama halterum*)[3]. The anterior wings are

[1] BLACKWELL, *Remarks on the pulvilli of Insects. Transact. of the Linn. Soc.* Vol. XVI. Pt. 3, pp. 487—492.

[2] OKEN names the wings of insects gills; the *elytra* of Coleoptera he considers, less happily, to be gill-covers; they must have the same anatomical interpretation, (*Bedeutung*), as the under-wings. *Lehrbuch der Naturphilosophie*, III. 1811, s. 271; the same work entirely revised. 1843, s. 316.

[3] See AUDOUIN, *Dict. class. d'Hist. nat.* II. pp. 140—142, at the word *Balanciers*, and NEWPORT, l. l. p. 926.

in some insects harder, horny and opaque; they are then called *wing-covers* (*elytra*), and the under-wings, usually larger, are when at rest folded transversely beneath the covers and concealed (as in Beetles, *Coleoptera*). In other instances the under wings disappear, and the wing-covers coalesce by their inner edges (*elytra coadunata*). *Hemelytra* is the name given to the anterior wings, when horny or coriaceous at the base but membraneous towards the apex (in *Hemiptera*, as *Water-scorpions*, *Nepa cinerea*, &c.)

The hinder-body (*abdomen*) constitutes the third portion of the body of Insects, and usually consists of nine rings, of which however the last are in some instances so much concealed, and in others so small or so fused with the preceding, that they seem to be entirely wanting. As the organs of sense have their seat in the head, and those of motion in the thorax, so do the principal organs of vegetative or organic life reside in the abdomen.

The digestive organs present differences according to the Orders and Families. Here the comparative length of the intestinal canal does not always depend, as in vertebrate animals, upon the nature of the food, and many species that live on animal substances have a longer and more convoluted canal than others which live on plants; in Grasshoppers for instance (*Grylli*, *Locustæ*) it is almost straight, though these insects live exclusively on vegetable food. In those Insects whose body consists of uniform rings (as the myriapods) and in vermiform larvæ of Insects with a complete Metamorphosis, the intestinal canal is straight, or makes only few and inconspicuous curves. The intestine has the greatest length in proportion to the body in certain *Coleoptera* and *Hemiptera*. In the last it is at least twice, often four or five times the length of the body (ex. gr. in *Lygæus apterus* FABR.); in *Cicada orni* the intestinal canal is about ten times as long as the body[1]. Amongst *Coleoptera* the *Scarabæides*, to which the common cockchafer belongs, are remarkable for their very long and tortuous intestinal canal, which in *Copris lunaris* measures ten or twelve times the length of the body.

The membranes or coats of the intestinal canal are, first, a thin covering, which without sufficient reason has been compared with

[1] LÉON DUFOUR, *Recherches anat. et physiol. sur les Hémiptères* (*Extrait des Mém. des savans étrangers*, Tom. IV.) Paris, 1833, 4to. p. 92, Pl. VIII. fig. 95.

the peritoneal covering of the intestines in vertebrate animals; next, a muscular coat of longitudinal and transverse fibres; then a white, smooth membrane, a layer of areolar tissue probably corresponding to the *tunica propria* of the intestine in vertebrates, but which is often beset with minute glands in transverse rows: and lastly the innermost membrane, an *Epithelium*, that occasionally, as in the muscular stomach of the *Orthoptera*, is found hard and horny, forming the teeth or sharp plates with which the stomach is armed.

In the intestinal canal of Insects several parts are to be distinguished: but it is much to be wished that writers in the names given to them had been careful to preserve greater uniformity. The first part is the œsophagus, it has often an expansion named *crop* (*ingluvies*); next follows a *muscular stomach* (*ventriculus musculosus, der Kaumagen, le gésier*, the *gizzard*); it is found in the *Orthoptera* and amongst the *Coleoptera* in the genera *Staphylinus, Dytiscus,* and the family of the *Carabici*[1], and is remarkable for the great development of the innermost coat, for the projecting plates, teeth or hooklets of corneous tissue which serve for bruising the food; it is usually folded and has a round, more or less spherical, form[2]. Then comes a long cylindrical *stomach* in which the proper digestion proceeds. Léon Dufour names it *ventricule chylifique;* Ramdohr calls it simply the stomach, which name appears to me to be sufficient and preferable to the other. This organ is always present, and beneath its termination the *vasa urinaria* (of which hereafter) are always inserted[3]. To this succeeds a longer or shorter, sometimes (as in the *Hemiptera*) a very short canal, the *small intestine* (*intestinum tenue*), which is continued into the short *large intestine* (*intest. crassum*), having occasionally a *cæcum* or expanded portion when the connexion takes place obliquely and at the side[4].

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[1] Léon Dufour has also discovered a muscular stomach in *Tomicus typographus. Ann. des Sc. nat.* IV. p. 108.

[2] Ramdohr names it *Faltenmagen* (*plicated stomach, omasus*), a very ill-chosen name.

[3] Marcel de Serres considered the stomach to be duodenum; in that case many insects must have no stomach at all. The name of Crop (*jabot succenturié*) by which Straus denotes this part in the Cockchafer is not explicable.

[4] We are indebted to Léon Dufour for most of the investigations of the intestinal canal in Insects. They were preceded by those of Ramdohr, who published a work on the subject, (*Abhandlungen über die Verdauungswerkzeuge der Insecten*, mit 30 Kupfertafeln, Halle, 1811, 4to).

The intestinal canal of Insects is connected to the other parts of the body partly by a large quantity of fat (the adipose body, of which below), and partly by numerous branches of air-tubes, and so retained in its place.

In very many Insects *Salivary Glands* are present; they are placed at the commencement of the intestinal canal. In *Coleoptera*, for the most part, they are wanting; RAMDOHR found them in *Curculio* (*Cryptorhynchus*) *lapathi*, LÉON DUFOUR, besides in other *Curculionida*, also in *Blaps*, *Diaperis*, *Mordella* and some other *Coleoptera;* moreover in the other orders of Insects they are present in by far the greater number of Families, probably in all *Orthoptera*, *Hymenoptera*, *Lepidoptera*, *Diptera* and *Myriapoda*. Amongst the *Neuroptera* they are wanting in *Libellula* and *Ephemera*, amongst the *Hemiptera* in *Aphides*. It is very remarkable, and not easily explicable, that in *Panorpa* amongst the *Neuroptera* the female has no salivary glands, or more correctly only small rudiments of them, whilst the male has them largely developed[1]. They have here the form of long convoluted canals (three on each side), which towards the end are turned upwards, and becoming thinner terminate by blind extremities. This form of blind convoluted canals occurs also in the salivary glands of some other insects, ex. gr. of the *Lepidoptera;* but it is by no means general, for in the *Hymenoptera* and *Orthoptera* these organs appear commonly as blind sacs grouped in clusters. Microscopic investigation has demonstrated in these salivary vessels and glands, as in other glands, a layer of epithelial cells with nuclei[2].

Below the inferior orifice of the stomach in Insects very fine vessels are implanted, the so-called *Malpighian vessels*, which in former times were generally looked upon as organs for the preparation of bile (*vasa hepatica*)—an opinion still maintained by LÉON DUFOUR, OWEN[3] and other writers. It is, on the other hand, the

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[1] Our meritorious countryman BRANTS first made this interesting observation, *Tijdschr. voor nat. Gesch. en Physiol.* VI. 1839, bl. 173—198. It was afterwards also made known by LÉON DUFOUR (*Mémoires présentés à l'Acad. royale des Sc.* VII. 1841, pp. 582, 583, Pl. 11, fig. 169,) who overlooked, however, the rudimentary salivary glands in the female.

[2] See the beautiful investigations of H. MECKEL, MUELLER'S *Archiv.* 1846, s. 25—35.

[3] [It is not to be inferred that OWEN holds this opinion now: his Lectures were published many years ago, and a new edition of them is now in the press.]

opinion of most writers of the present day, that they correspond to the kidneys of the higher animals, whence the term used above p. 254, (*vasa urinaria*) for these vessels. Besides other grounds for this opinion, it is supported by chemical investigation[1]. These vessels appear to be present in all Insects, with the exception of *Aphidii* amongst the *Hemiptera*, where it has not been possible to find a trace of them. Their number is very different, and seems to be on the whole inversely proportional to their length; they are short and very numerous, more than twenty, in the *Hymenoptera* and *Orthoptera*, and in *Libellula* and *Ephemera* amongst the *Neuroptera*. Here they are arranged in a ring round the intestinal canal which they perforate, whilst at the free extremity they terminate cœcally. In *Gryllotalpa* and *Acheta* FABR. they fall into a common canal before opening into the intestine. In the remaining Insects there are usually only four or two of them present (*Diptera*, *Hemiptera*, many *Coleoptera*), or six, as in other *Coleoptera* (the *Heteromerata*, *Tetramerata*, and *Trimerata*). When there are only two, they form a loop on each side of the intestinal canal, which seems to arise from the fusion of two vessels; and so open by four terminations into the canal. In those *Coleoptera* which have six, they are also attached to the inferior extremity of the intestinal canal (the *Rectum*), but do not open into it there; they run upwards as very fine vessels between the coats of the intestine and terminate blindly[2].

If we consider these organs as Kidneys it becomes uncertain whether Insects have a Liver; for the idea that these vessels may represent at once both Kidneys and Liver (whence it has been proposed to name them *vasa urino-biliaria*) is not, as appears to me, the result of comparative investigation either anatomical or

[1] See RENGGER'S *Physiologische Untersuchungen über die thierische Haushaltung der Insecten*, Tubingen, 1817, 8vo. Comp. WÜRZER, *Chemische Untersuchung des Stoffes, welcher sich in den sogenannten Gallengefässen des Schmetterlings der Seidenraupe befindet* in MECKEL'S *Archiv.* IV. 1818, s. 213—215. Also CHEVREUL found in the matter of these vessels potass, ammonia and *uric acid;* see STRAUS *Considérations générales sur l'Anatomie des Anim. articulés, auxquelles on a joint l'Anat. descriptive du Melolontha vulgaris.* Paris, 1828, 4to, p. 251. In a *Lucanus* little stones have been found in these canals consisting of *uric acid.* AUDOUIN *Ann. des Sc. nat.* 2e Sér. Tom. v. 1836, p. 129. C. VERLOREN found in larvæ of *Lepidoptera* (*Sphinx ligustri*) no *uric acid* in these vessels, but *hippuric acid*, as he informed me by letter in 1843.

[2] LÉON DUFOUR, *Mém. sur les vaisseaux biliaires des Insectes. Ann. des Sc. nat.* 2e Série, Tom. XIX. 1843, pp. 145—182, Pl. 6—9.

physiological, and would never have been entertained but for the attempt to reconcile two conflicting views, and which ought always to be distrusted when it interferes with more extended enquiry. But if we suppose an organ answering to the liver to be altogether wanting in insects, then it must be proved that the separation of bile is more important in the animal economy than the excretion of urea, before an argument can be borrowed therefrom against the function ascribed to the Malpighian vessels. We do not forget that by respiration and the elaboration of bile the quantity of carbon in the living body is diminished, and that from the large development of the respiratory organs in insects the excretory office of the liver is in a great measure dropped[1]. Nevertheless it is still highly probable that parts, whose function agrees with that of a liver, are not altogether absent in Insects. In the first place we might here refer to the great quantity of fat—the adipose body—situated between the skin and the intestine, which invests every organ and is of very great extent, more especially in larvæ whose respiration is less perfect; the carbon and hydrogen which in other instances is combined with oxygen to quit the body by respiration, here forms that provision of combustible matter so necessary in the animal economy for the support of respiration, especially in the case of Insects, which as Nymphs take scarcely any food. Since then this production of fat exerts the same influence on the composition of the fluids as the separation of bile, it is not to be considered as a proceeding entirely arbitrary if some recognise in the adipose body an analogon of the liver[2]. The adipose body consists of a multitude of minute sacs or vesicles bound together by air-tubes which spread themselves as a fine network on their surface. In the second place, cœcal appendages are seen below the muscular stomach in the *Orthoptere* (eight in *Mantis*, six in *Gryllus*, two in *Acheta*) which involuntarily call to mind the *appendices pyloricæ* of osseous fishes: they probably secrete a fluid that performs the office of the bile in digestion[3]. In other insects, finally, as in the *Carabici* among the

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[1] Burmeister *Handb. der Entomol.* I. p. 403.

[2] Oken *Lehrb. der Naturphilosophie*, III. 1811, s. 270 (*3tte Auflage*, s. 425).

[3] That these blind appendages arise from an immediate extension (protrusion) of the intestinal canal is no proof, as Léon Dufour supposes, that they cannot be secretory

*Coleoptera* the entire stomach (*ventricule chylifique* DUFOUR) is beset with numberless conical or filiform saccules, giving a flocculent aspect to its external surface. It may be, that these parts, whose office was formerly supposed erroneously to be the absorption of nutrient fluid from the intestine, prepare the bile: but it seems more probable that they serve to separate the gastric juice[1].

The Heart of Insects has the form of a long vessel that terminates behind by a blind extremity and lies above the intestinal canal on the dorsal surface. This *dorsal vessel* becomes narrower forwards, after it has curved slightly downwards. The smaller part may be considered to be an artery, whilst the wider posterior portion answers more closely to the heart of other creatures. In this posterior part are different lateral openings, mostly eight or nine pairs: and in front of each opening is a valve formed by a duplicature inwards of the wall. In the diastole of the heart the blood flows into it between two sets of valves, of which the posterior pair come into apposition, whilst the anterior lie folded against the wall and so permit the onward motion of the blood. Systole and diastole succeed each other alternately, moving along the length of the dorsal vessel from behind forwards. SWAMMERDAM long ago, and STRAUS in more recent times noticed in the dorsal vessel longitudinal and transverse muscular fibres, the latter forming the innermost layer. Surrounding the heart is a space which some writers consider to be a *sinus venosus;* it is covered by lateral muscles, flat, and of triangular form, which have their broad base towards the heart and fix it in its position (*les ailes du Cœur* of LYONET). From behind, the blood flows through the lateral openings into the heart, and moves forwards; from before, it flows from the aorta between the organs, especially along the course of

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organs. *Mém. présentés.* VII. p. 302. In *Leucopsis* also amongst the *Hymenoptera* two such blind saccules are met with; LÉON DUFOUR, *ibid.* p. 524.

[1] The great uncertainty which prevails concerning the interpretation of the secretory organs in the lower animals, is a necessary consequence of the fact that the selfsame secretion, as we learn from comparative anatomy, may be effected by very differently formed glands; see J. MUELLER'S *Handb. der Physiol.*, II. Buch, *Abschn.* 2 (I. Bd., s. 457, *3te Aufl.*) Chemical investigation alone can here afford light, and a beginning of the enquiry has been made in invertebrate animals in these last years. C. SCHMIDT'S Investigations: *Zur vergleichenden Physiologie der wirbellosen Thiere*, Braunschweig, 1835, deserve, therefore, our thanks, and make us hope for further communications.

the air-tubes, in regular streams backwards. These streams of blood on the outside of the heart were first observed by CARUS twenty years ago in the three fin-shaped caudal processes of the larva of *Agrion*; afterwards he observed a similar motion of fluid in the imperfect wings of the Nymphs; the blood-globules (according to many, rather according to VÉRLOREN, the fat-globules), which swimming in a clear fluid indicate the direction of the current. The later observations of various authors, on transparent larvæ principally, have ascertained the phenomenon in Insects of every order—and it may therefore be confidently accepted as general. A question which requires further investigation for its solution is this, whether the circulation is effected in vessels, as *ex. gr.* NEWPORT and BOWERBANK believe, or in free spaces between the organs, without special walls. The writers who maintain the latter opinion, allege that the *Aorta* has an open termination in the Head. In the *Myriapoda*, besides the dorsal vessel, there are still others present; amongst which a trunk that lies upon the nervous cord in the abdomen, ought to be mentioned. In the Butterflies also TREVERANUS discovered on the ventral surface a vessel, lying on the nervous cord and running longitudinally, from which on each side numerous transverse branches arise[1]. NEWPORT found this vessel in the genus *Sphinx*, and thinks that the blood flows in it backwards, as it does forwards in the aorta. This last author discovered in this same genus, and in certain *Coleoptera* branches from the aorta in the head, but was not able, on account of the delicacy of the parts, to follow their further course[2].

The Respiratory organs of Insects are their air-canals (*trachecæ*),

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[1] *Zeitschr. für Physiol.* IV. 2, 1832, s. 181—184, Taf. XIV. fig. 13.

[2] Comp. on the dorsal vessel and the circulation of insects LYONET, *Traité Anat. de la Chenille*, pp. 413, &c.; on the fluid contained in it, *ibid.* pp. 426, 427; HEROLD, *Physiol. Untersuchungen über das Rückengefäss der Insecten*, Marburg, 1823, 8vo.; STRAUS *Anat. comp. des Anim. articulés*, pp. 345—358; J. MUELLER, *Nov. Act. Acad. Cæs. Leop. Car.* Tom. XII. 2, 1825 (on a connexion between the dorsal vessel and the ovaries); C. G. CARUS, *Entdeckung eines einfachen vom Herzen aus beschleunigten Blutkreislaufes in den Larven netzflüglicher Insecten.* Mit 3 Kupfert. Leipzig, 1827, 4to; WAGNER, *Beobachtungen üb. d. Kreislauf des Blutes u. d. Bau des Rückengefässes bei den Insecten*, OKEN'S *Isis*, 1832, s. 320—331, Taf. II.; NEWPORT, TODD'S *Encyclop.* II. pp. 975—982. The treatise of our excellent M. C. VERLOREN, crowned by the Brussels Academy of Sciences in 1844 (!) is impatiently waited for; I have made use of the observations he had the goodness to communicate to me when treating of the dorsal vessel.

which are usually filled with air by external openings (*stigmata*). These canals have three coats: an external, loose, transparent membrane, in which fibres and scattered points (cell-nuclei) may be distinguished; a middle, composed of a flat, horny, sometimes brown or yellow elastic thread rolled spirally: and an inner coat which is composed of *chitine*, a continuation of the external skin, and is thrown off at every moult[1]. Through the elasticity of the spiral thread the air-canals are duly kept open: its turns lie close to each other, and so the appearance of rings is produced, as in the wind-pipe of mammals (this the representation of the tracheæ of *Pediculus* in SWAMMERDAM, *Bibl. natur.* Tab. I. fig. VII. resembles too closely); but the similarity is only in appearance; there are no absolute rings, but only the turns of a single uninterrupted thread. Each branch, arising from a stem, has a new thread, whether the branch proceeds laterally from the stem, or two branches arise at the end of the stem; this thread is finer than that of the stem, and in the terminal branches is only visible when very highly magnified. From being full of air, the canals, when Insects are dissected under water, have a silvery splendour, and present on account of the extreme fineness of their branching a very beautiful appearance to the observer[2]. Usually the air-canals divide, like arteries, into continually finer branches. In some Insects however there spring from a large stem on every side throughout a greater or less extent extremely fine and numerous branches (as *ex. gr.* according to LÉON DUFOUR, in *Prionus*, from the double stem which lies between the last *stigma* of the thorax, and the first of the abdomen). In *Nepa* and *Ranatra* saccules are seen in the cavity of the thorax, between which similar fine branches (*retia mirabilia*) of the air-canals lie, and which are surrounded by a muscular coat[3]. Care must be taken to distinguish these saccules from the sacculated dilatations of the air-canals themselves, which are met with in flying Insects in the last period of

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[1] It has not been made out, as far as I know, whether the innermost membrane of the air-tubes is present in those insects also which have no stigmata, but gill-plates, as the larvæ of *Ephemera*, for instance.

[2] M. MALPIGHI, who first made use of the names of *tracheæ* and *stigmata*, says, "*Tanta est fructificatio horum vasorum, tam miræ implicationes ut nil pulchrius conspici possit.*" *De Bombyce*, p. 12. *Opera om.* Tom. II. Londini, 1687, fol.

[3] LÉON DUFOUR, *Rech. sur les Hémiptères*, p. 253, Pl. XVIII.

their life, and which beyond doubt are of service in diminishing weight during flight. These dilatations are oval or pear-shaped, and occasionally a tubular *trachea* proceeds anew from their further side. In the *Apiariæ* amongst the *Hymenoptera*, the two lateral main trunks of the air-canals in the abdomen are in this way converted into large reservoirs of air.

The *stigmata* are present in different numbers in the hexapod Insects, but it is rare to find more than nine pairs of them; in *Dytiscus* amongst the *Coleoptera* and in *Locusta* amongst the *Orthoptera* there are ten pairs (BURMEISTER *Handbuch der Entomologie* I. p. 175). Also in *Gryllotalpa* I found ten pairs, three in the thorax and seven in the abdomen. These air-slits are small, generally oblong fissures (like button-holes), often surrounded by a horny ring (*peritrema*) with a cavity behind them which again, by a second fissure whose posterior half can be retracted by muscles, leads to the air-canals. In other instances there is no peritrema, but the *stigma* is formed by a fissure between two lips, whose edges are beset with hairs. Sometimes there are in the cavity of the *stigma* special moveable horny plates (*epiglottides* STRAUS), which can close the entrance of the air-canal that proceeds from it. By means of the oblique position of the lips, of which one often projects over the other, by means of the narrow opening, and of the hair or down on their edge, the entrance of dust or other small bodies into the *stigmata* is prevented, whilst the air alone is admitted as through a sieve. From every air-slit, or its cavity (vestibule) there arises an air-canal (*trachée d'origine* STRAUS) which divides into numerous branches (in *Scolopendra*), or proceeds transversely after having given off one or two lateral main-stems. These main-stems running along the length of the body, (in most Insects there is only one on each side,) receive all the canals that spring from the air-slits or fissures, and connect them together. They give off the numerous branches which spread through every part of the body. The distribution of the air-canals after the manner of vessels is interesting; by such a disposition of the respiratory organs in Insects, the atmospheric air has access in equal degree to every part of their body[1]. But it is too much to

[1] "*In nobis et consimilibus sanguinis massa pulmones petit... in insectis non tota sanguinis moles in pulmones confluit, sed inversa via pulmones ipsi, vasorum ritu, in*

conclude from hence that the circulation of blood is unnecessary in Insects, and consequently does not exist. The circulation of blood has not respect to respiration alone, it is not merely for the conversion of venous blood into arterial; it is necessary that arterial blood should circulate that it may serve for nutrition and secretion.

Many Insects live in water: but of these the greater number breathe atmospheric air; like whales amongst mammals some come to the surface of the water for that purpose. But usually there are special arrangements for conducting the air, so that the Insect can remain under water. This is seen *ex. gr.* in the larvæ of *Diptera*, which live under water; those of *Culex* have at the posterior part of the body a lateral canal with fine hairs at the orifice; the larvæ of *Stratiomys* have a canal at the end of the abdomen, whose orifice is fringed with a circlet of plumose hairs; the genera *Nepa* and *Ranatra* have a tail composed of two filaments at whose base are two air-slits[1]. These water-insects die in a few hours if the air has no access to the water. Other Insects breathe in the water itself, that is, they breathe the air that is diffused through the water, as fishes do by their gills. Such Insects have no air-slits: the air must therefore penetrate the walls of the *tracheæ*, which to that end are spread out either in filiform or capillary appendages (in the larvæ of *Gyrinus*, of *Semblis*, the *nymphæ* of *Chironomus*) or in leaf-like plates at one side of the body (*Ephemera*), or at the extremity of the abdomen (*Agrion*). These parts have been termed *Gills*[2]; they are not found in perfect Insects. Gills of this sort, from which blind air-tubes arise, occur in the rectum of the larva of *Libellula* as five rows of plumose incised leaflets. From them arise six longitudinal stems, of which two, larger than the rest,

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*universum corpus dispergantur, sic ut singulæ partes aeris particulas per pulmones et sanguinis portiones per arterias recipiat.*" MALPIGHI *Anatome plantarum, Op. om.* I. p. 15.

[1] Figures of *Culex* in SWAMMERDAM, *Bibl. nat.* Tab. XXXI. figs. 4, 5; of *Stratiomys*, *ibid.* Tab. XXXIX.; of *Nepa*, in DUFOUR, l. l. The abdomen of *Nepa* and *Ranatra* has besides three pair of conspicuous, but closed, air-slits, in which very large branches of air-tubes terminate with blind ends.

[2] This nomenclature is only in part correct. The proper respiratory organs of Insects, the air-tubes, belong to the category of lungs, whether the air penetrates by external apertures (*stigmata*), or the tubes be filled with air from endosmotic action. The air in fact is in the inside, and the stream of blood (along the tracheæ) on the outside, and this relation is just the reverse of that which prevails in gills.

become afterwards the main trunks of the perfect Insect which are in connexion with the air-slits[1].

Observations have shewn that Respiration in Insects effects the same chemical changes of the air, as in higher creatures; respiration is more active, the need of air greater and the production of carbonic acid more abundant in the perfect Insect than in the larva. In the perfect Insect, moreover, respiration is performed principally by the air-slits of the thorax, which are larger than those of the abdomen, whilst in the larva that function is distributed more equally amongst all the stigmata. This fact is in connexion with the development of the thorax and with the mechanism for motion affixed there in the perfect Insect. Accurate investigations have shewn that Insects, at least under certain circumstances, have a *proper warmth*, and that they can raise the temperature of their body remarkably by motion, or by voluntary acceleration of respiration[2].

The sexes are distinct in all Insects, and the eggs are not fertilized, as in fishes, after they are laid, but union of the sexes must precede the laying of the eggs if they are to prove fruitful. A remarkable peculiarity has been observed in Plant Lice (*Aphides*),

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[1] Comp. on the respiratory organs of insects, besides MALPIGHI, SWAMMERDAM, LYONET, STRAUS and other writers already cited, C. SPRENGEL *Commentarius de partibus, quibus Insecta spiritum ducunt*, Lipsiæ, 1815, 4to. *cum tabulis;* SUCKOW, *Respiration der Insecten, insbesondere über die Darmrespiration der Aeschna grandis*, HEUSINGER'S *Zeitsch. f. die organ. Physik.* II. 1828, s. 24—29; BURMEISTER *Handb. der Entomol.* I, s. 169—194 (a very careful revision of the observations of others and of his own) and NEWPORT, *Phil. Trans.* 1836, Pt. 2, pp. 529—566 (or in TODD'S *Cyclop.* II. pp. 982—990). We refer also to the beautiful figures in LYONET *Traité an. de la Chenille*, Pl. XXI., and STRAUS *Anat. des anim. artic.* Pl. 7, in order to give an idea of the minute division of the air-tubes. MARCEL DE SERRES has figured the tracheæ and air-sacs in some *Orthoptera* (*Truxalis, Mantis*) in *Mém. du Muséum*, IV. Pl. 15, 16.

[2] Already in 1792 VAUGUELIN had made experiments on the respiration of Insects (*Locusta viridissima*). Comp. also G. R. TREVIRANUS, *Versuche über das Athemholen der niedern Thiere, Zeitschr. f. Physiol.* IV. 1831, s. 1—39, and NEWPORT, *Phil. Trans.* l. l., for the specific warmth, which was formerly denied by J. DAVY, against whose observations NOBILI and MELLONI had already advanced objections (*Ann. de Chim. et de Physique*, 1831, Octobre, pp. 207—210). All animals, LIEBIG justly observes, are warm-blooded, but only in such as breathe by lungs (better, in mammals and birds), is the specific warmth entirely independent of the external temperature. *Die organ. Chemie in ihrer Anwendung auf Physiol. u. Pathol.* 1842, s. 20. Comp. also BERTHOLD, *Neue Versuche üb. d. Temperatur der kaltblütige Thiere*, Göttingen, 1825, s. 35, 36, s. 42.

where a single impregnation suffices for many families in succession; the males are not observed until the end of summer or in autumn; they impregnate the last family, consisting of wingless females, which without copulation would be barren. Their eggs remain during the winter on branches of trees, and in spring produce only female plant-lice which without copulation are prolific and viviparous. BONNET, to whom we owe this discovery, found that in the space of three months nine successive generations were produced without copulation[1].

Amongst the *Myriapoda* the Chilopods have only a single ovary, in form of a long sac situated beneath the intestine. In the remaining Insects there are two ovaries. Sometimes they have the same form of tubes or sacs (*Forficula*, *Ephemera*, *Stratiomys*); in some flies the sac is very long, rolled spirally like a watch-spring, and separated by many transverse partitions into cells[2]. In most Insects each ovary consists of a number of tubes (*gaines ovigères* LÉON DUFOUR). Sometimes these are situated around a sacciform dilatation from which the oviduct arises (*ovaria baccata*), as in *Meloë* L. and *Lycus* (*coleoptera*)[3]. Or these tubes are situated lengthwise along the origin of oviduct (*ovaria ramosa*), as in *Cicada*[4]; sometimes on one side only, like the teeth of a comb, as in *Phasma* and *Tenthredo* (*Athalia*). But in by far the greatest number of cases, these tubes are situated at the beginning of the oviduct like the leaflets of a digitated leaf, at the end of a common stalk (*ovaria digitata*, *fasciculata*). Such ovaries are seen in the *Lepidoptera*, where each of them consists of four tubes. The number of these tubes is however very different, not only in the different orders, but even in the same order, and occasionally in the same natural family; whilst, *ex. gr. Bombyx* and *Xylocopa* (*Hymenoptera*) have four, in the Honey-Bee are more than one hundred[5]. In

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[1] C. BONNET, *Traité d'Insectologie*, I. *Observations sur les Pucerons*, Paris, 1845, 12mo. *Œuvres* I. 1771, 8vo. DUVAU has obtained even eleven successive generations without copulation; *Ann. des Sc. nat.* V. 1825, p. 224. There are also some examples of the same phenomenon in insects of other orders. BURMEISTER, l. l. s. 336, 337.

[2] RÉAUMUR, *Mém. pour servir à l'Hist. des Ins.* IV. Pl. 29, f. 7 and 8.

[3] BRANDT and RATZEBURG, *Medizin. Zoologie* II. Tab. XVII. fig. 2 k, *Meloe variegatus*, Tab. XIX. figs. 11, 15, *Lytta vesicatoria*; LÉON DUFOUR, *Ann. des. Sc. nat.* VI. Pl. 18, fig. 1, *Lycus rufipennis*.

[4] LÉON DUFOUR, *Hémiptères*, Pl. 17, fig. 189.

[5] LÉON DUFOUR, *Mém. présentés*, Tom. VII. p. 408. According to SWAMMERDAM,

many *Hemiptera heteroptera* there are seven, as also in many *Carabici;* the Cockchafer and other *Lamellicornia* have six, the Stag-Beetle (*Lucanus cervus*) twelve, &c. The length of these tubes is different, but on the whole is more marked in proportion as the number is fewer, as in the Butterflies; they contain the eggs in a string; the largest and most developed are at the lower end, the smaller above. Here the ovarial tubes run out into a fine thread which LÉON DUFOUR terms Suspensory Ligament, whilst J. MUELLER considers the parts to be vessels which connect the ovaries with the dorsal vessel. In most instances the threads unite on each side to form a cord; in others (in *Phasma ex. gr.*) they proceed separately to the dorsal vessel.

From the inferior termination of the ovaries proceed two oviducts (*tubæ*), which coalesce to form a common tube beneath the rectum: it is ordinarily much shorter than the *tubæ;* in the cockchafer, on the contrary, it is longer than these. Different horny plates surround the dilated inferior termination of this common tube; it has a sphincter muscle to contract it, as well as several others[1]. Generally it falls, with the rectum, into a common *cloaca*, or it opens beneath and in front of the *anus*. Sometimes the external sexual organs of the female, generally seated in the ninth ring of the abdomen, which is included and hidden in the eighth, are prolonged into an appendage externally. Here belongs the tubular vagina of Flies (*vagina tubiformis*), in *Chrysis*, &c.[2], which is formed of the last abdominal rings that can be drawn within each other like an opera-glass. In others the vagina is *two-valved* (*vagina bivalvis*), as in Locusts (*Locustæ*), and projects beyond the last segment of the abdomen as an ensiform compressed prolongation. In others there is a perforator *borer* (*terebra*) or a *sting* (*aculeus*); here, besides the bivalved vagina, there is a sharp organ for puncturing, with serrated edges, and composed of one or of two horny threads; when at rest the sting is concealed within the abdomen; it is connected with a poison-gland[3].

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who has given a highly magnified figure of these parts, each *ovarium* consists in the Honey-Bee of 150 tubes, *Bibl. natur.* p. 471, Tab. XIX. fig. 3.

[1] See STRAUS, *Anat. des anim. art.* p. 299, and the figures of the Cockchafer, ibid. Pl. 5, figs. 4, 5 *m*, Pl. 6, fig. 2 *k*, *k'*.

[2] Also in *Mycterus curculoïdes* amongst the *Coleoptera*, *Ann. des Sc. nat.* Tom. VI. Pl. 19, fig. 5.

[3] Comp. here especially BURMEISTER, *Handb. der Entom.* I. s. 209—215, Taf. 12.

Different appendages belong to the common oviduct, or to the vagina. Of these one is more constant than the rest, and opens into the common oviduct, close to the uppermost part, where this is formed from the union of the two tubes. Previous to copulation it is empty, but after that act is filled with a white fluid—which is the seed, as microscopic investigation has demonstrated beyond doubt, from the presence of the hair-like *spermatozoa* in motion. This part, generally single, may therefore be called *receptaculum seminis*. Frequently it has an appendage (*glandula appendicularis*). In many insects there is another vesicle present which, during copulation, receives the *penis* (*bursa copulatrix, poche copulatrice* AUDOUIN), and which in the cockchafer is a large bladder beneath the oviduct. In the Butterflies this organ opens externally, and not into the oviduct, so that there are two sexual orifices, whilst a canal leads from the *bursa copulatrix* to the oviduct, and conducts the seed into the *receptaculum seminis* situated above. There are other vesicles, or glands, generally in pairs and situated more behind for the purpose of covering the eggs with an adhesive fluid. In the Butterflies these are seen as two pyriform vesicles laid transversely with their broad bases opposed, which at the other end pass into a very long, contorted, blind canal. In a few Insects still other secretory organs have been observed, which probably secrete a peculiar odorous matter to attract the male[1].

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On the borer (*terebra*) in the *Cicadæ*, see DOYÈRE in *Ann. des Sc. nat.* 2e Série, VII. *Zoologie*, pp. 193—199, Pl. 8, the middle bristle (*le poinçon* DOYÈRE) works like a wedge.

[1] It is difficult to be brief on a subject which has reference to such an important difference of organisation, and which, on account of the various views of observers, possesses an historical interest. MALPIGHI (*de Bombyce*) long ago recognised the *vesicula copulatrix* as the organ which receives the penis and gave it the name of *uterus;* often the penis or a part of it is broken off, and remains here after copulation. The penis is figured in this part in *Sphinx ligustri* from a preparation by HUNTER in the *Catalogue* of the *Physiological Series of the Museum of the College of Surgeons*, Vol. v. London, 1840, Pl. 67, fig. 8. It was with fluid from this vesicle that HUNTER impregnated artificially the eggs of other butterflies. *Phil. Trans.* 1792, p. 175 (in *Bombyx mori*); an experiment already devised by MALPIGHI, but attempted without success. SPALLANZANI, before HUNTER had effected the artificial impregnation of the eggs of the silkworm, but with the seed taken directly from the male butterfly, so that his experiment does not belong to our present subject (*Expériences pour servir à l'Hist. de la Génér.* Genève, 1785, 8. p. 223). AUDOUIN has the honour of having been the first in our century to direct attention to this subject, whilst previously all these

The male individuals amongst Insects have usually two *testes*, though there be occasionally only one, just as in the female there may be only one *ovarium*. Such is the case with *Lithobius* where the part has the form of a long tortuous canal. In the *Scolopendræ* proper (*Scol. morsitans*, &c.) are different oval *testes*, much extended in length, (described improperly by KUTORGA as *epididymides*) which at each pointed extremity send off an efferent canal; all these canals coalesce to form a single canal which is very tortuous and widens into a sac below (*testiculus* KUTORGA[1]). In *Scutigera* there are two very tortuous canals (*testiculi?*) present, which begin with an oval sacciform expansion, and then pass into a single fine tube, of great length and winding right and left with close curves; this tube opens into a canal, which as an arc connects the two efferent canals each of which dilates twice into an oval vesicle[2]. In *Julus* there are two long blind tubes, which, connected by transverse canals, have the form of a ladder, and to which laterally blind sacs are appended; these sacs may be considered to be *testes* and the two longitudinal canals to be *vasa deferentia*[3].

In the hexapod Insects the parts which prepare the seed are always in pairs. There is found indeed in most *Lepidoptera* and in certain *Coleoptera* (*ex. gr.* in *Ophonus* and *Harpalus*, genera of the family of the *Carabici*) a single *testis*[4], but since two efferent canals arise from its lower edge, it is obviously formed by the union of two

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appendages had been confounded together as secreting organs, *Ann. des Sc. nat.* II. 1824, p. 281. We owe to C. TH. VON SIEBOLD the most complete investigation of this subject; see his *Fernere Beobachtungen über die Spermatozoa der wirbellosen Thiere*, in MUELLER'S *Archiv.* 1837, s. 392—433. If, as VON SIEBOLD assures us, the *vesicula copulatrix* only seldom contains *Spermatozoa*, and then usually dead ones, it is less to be wondered at that the experiments of MALPIGHI failed than that those of HUNTER succeeded; they ought to be repeated with better success with the fluid from the *receptaculum seminis*. LÉON DUFOUR still persists in considering all these appendages as *glandes sébifiques*.

[1] S. KUTORGA, *Scolopendræ morsitantis Anatome*, Petropoli, 1834, 4to. pp. 10, 11, Tab. II. figs. 3—5; RYMER JONES in TODD'S *Cyclop.* II. p. 423, fig. 201.

[2] LÉON DUFOUR, who has given a description and figure of these parts, considers the first pair of these vesicular expansions as *testes*; the tortuous canals as *vesiculæ seminales*, *Ann. des Sc. nat.* II. 1824, p. 97, Pl. V. fig. 3.

[3] See figures in TODD'S *Cyclopæd.* III. p. 551, (article *Myriapoda*, by RYMER JONES) and by STEIN in MUELLER'S *Archiv.* 1842, Taf. XIII. figs. 17, 18.

[4] LÉON DUFOUR, *Ann. des Sc. nat.* VI. p. 133, Tab. VI. fig. 8 of *Harpalus ruficornis* (copied in WAGNER'S *Icon. Physiol.* Tab. XIX. fig. 8).

which were originally distinct, as at least in Butterflies is placed beyond all doubt by the history of development. In many *Hymenoptera* the two *testes* lie side by side in a common covering (*scrotum* DUFOUR). Sometimes these organs, usually white, are distinguished by lively colours (deep red in *Papilio brassicæ*, and in some *Hemiptera*, yellow or orange-coloured in some *Coleoptera*) which depend upon the investing membrane. Moreover the structure of the *testes* is very manifold, and, as in glands generally, nature has here solved the problem, in a small given space to increase as much as possible the secretory surface, in very different ways. The simplest form is that of a single blind canal, which is sometimes very tortuous[1]. In other cases this blind canal has more the form of a sac, *ex. gr.* in *Scutellera*, *Edessa*. Yet they are not always constructed in this simple way, when they have externally the form of a single blind sac and have also been so described by some writers; in *Libellula*, for instance, this sac contains a number of small round vesicles[2]. In by far the greatest number of Insects each *testis* consists of a collection of different, sometimes very numerous, vesicles, or cylindrical canals (*capsules séminifiques* LÉON DUFOUR) terminating blindly, which are united in form of a fan, of a star, of an umbel, or in bunches, and from which canals arise that afterwards terminate in a single efferent canal[3]. This efferent canal forms sometimes at its commencement numerous tortuosities, to which the name of *epididymis* has been given (as in many *Carabici*, in *Melolontha*[4], in *Nepa*, &c.). The lowest part has often an expansion[5] to which the name of *vesicula seminalis* has been fitly given. Far less propriety is there in giving this name to different blind canals which are met

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[1] In *Dytiscus marginalis* the entire canal when unwound appears to surpass the length of the animal twenty times, HEGETSCHWEILER *De Insector. genital.* p. 19.

[2] LÉON DUFOUR, *Mém. présentés*, VII. p. 572.

[3] For a methodical review of all these forms an arrangement is requisite in which, at the same time, there are not too many divisions. Comp. JOH. MUELLER, *De glandularum secernentium structura penitiori*, 1830. fol. p. 103; BURMEISTER, *Handb. der Entom.* I. s. 217—219; WAGNER'S *Lehrb. der vergl. Anat.* 1834, s. 329—332, and the figures chiefly borrowed from LÉON DUFOUR'S numerous investigations in MUELLER, l. l. Tab. XVI. figs. 1—19, and in WAGNER, *Icones Physiol.* 1839, Tab. XIX. figs. 1—26.

[4] STRAUS, l. l. Tab. VI. fig. 1, *c*, *c*.

[5] For instance, in *Hydrophilus*, in *Apis mellifica*, in *Gerris* and *Velia* (LÉON DUFOUR, *Rech. s. l. Hémipt.* Tab. XI. figs. 138, 139), in *Cossus marginatus* (LÉON DUFOUR, *ib.* Tab. X. fig. 127).

with in most Insects and which unite with the efferent canal. That these parts rather serve to effect special secretions and correspond with the *prostate* and COWPER'S glands in higher creatures is probable even from their composite structure and great development. Hence in some Insects they have been even described as *testiculi* and the true *testes* as glands of an unknown use, as for instance, by SWAMMERDAM in *Oryctes nasicornis*[1]. In this and other *Lamellicornia* (*Melolontha*, *Cetonia*) these glands are two tortuous canals, which resemble the *testiculi* of the *Carabici*. In *Hydrophilus piceus* these parts exceed the *testes* in circumference. Ordinarily there is one pair[2]: often also there are two pairs of these accessory organs present; in some are found three or even more pairs. They are entirely absent only in few Insects (*Gersis*, *Velia*, *Ranatra*). In *Libellula* they are also wanting[3]; yet I think it is nearer the truth to say that here they are not connected with the *testiculi* and are present in an unusual situation, which is in agreement with the copulation of these animals[4]. From this also it is apparent that these organs are not *vesiculæ seminales*.

For determining the purpose of the different parts connected with the organs of propagation microscopic investigation in the recent state is of great service. C. TH. VON SIEBOLD has never met with *spermatozoa* in the parts which we consider subservient to special secretions, which however they ought to contain if they were really seminal vesicles as LÉON DUFOUR and other writers suppose. The spermatozoa of Insects are like hairs, and are often found in the *testes* united in bundles and surrounded by a transparent covering[5].

We must notice, in addition, that in many species of Insects a great similarity of form has been observed between the organs of propagation in the two sexes. We see this resemblance in certain

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[1] *Bijbel der natuur*. Tab. XXX. fig. 8, *m m*; these are the true *testes*. I could almost suppose that LÉON DUFOUR so indefatigably laborious in the anatomy of Insects and so rich in experience, has made the same mistake in *Pelogonus*; see the *Rech. sur les Hémipt.* Pl. XI. fig. 137 A., where I consider the spiral organs *b b* to be *testes*.

[2] As in the *Hymenoptera*, for instance.

[3] LÉON DUFOUR, *Mém. présentés*, VII. p. 572.

[4] See below, in the systematic arrangement, in the family of the *Libellulina*.

[5] See VON SIEBOLD, *Ueb. die Spermatozoen der Crustaceen, Insecten, Gasteropoden u. einiger anderen wirbellosen Thiere*, MUELLER'S *Archiv*. 1836, s. 10—43, Tab. II.

beetles, but especially in several *Hemiptera*, as well in the form of the accessory glands, as in that of the *testes* and *ovaria*, in the number of the oviducts in the last and of the spermatic ducts in the former, &c. We cannot however admit that this similarity has the value of a general rule; the *Lepidoptera*, for instance, not to speak of other Insects, exhibit an entirely different type in the two sexes.

The external sexual organs lie, as in the females, at the hindmost part of the abdomen[1]. The penis has a very different form and substance. Ordinarily it is surrounded by two horny plates, and enclosed in a membraneous sac in the retracted condition; in the *Coleoptera* the penis is covered by a horny case, and supported by two horny threads[2].

Amongst the malformations of Insects hermaphroditic individuals occasionally occur, in which one half of the body is male, the other female, like the *Androgynæ* in Africa, of whom the ancients fabled, and who had a female breast on the left side, and a male on the right[3]. This lateral bisexuality is most frequently seen in Butterflies, in which it strikes the eye more readily from the form of the antennæ or the colour of the wings[4]; yet some instances of it are known in other orders also[5].

Before we turn from the consideration of the sexual organs of Insects we must shortly notice another peculiarity observed in bees and other *Hymenoptera* living in societies. Amongst these many

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[1] The *Chilognatha* (*Julus*) are an exception to this; the parts, in both sexes, are here situated very far forward, at a short distance from the head. They are also double (two *vulvæ*, two *penes*), as in the *crustacea*.

[2] See the figures of STRAUS (op. cit.) in the Cockchafer, Pl. II. figs. 21, 22, Pl. VI. fig. 1. WAGNER compares these horny threads with the *ossiculum penis*, found in many mammals. On the sexual organs of insects, in addition to the works cited above, two monographs (both, however, of somewhat old date) may be consulted, viz. J. J. HEGETSCHWEILER, *Diss. de Insectorum genitalibus; cum Tab.* Turici, 1820, 4to. and *Geslechtsorgane der Insecten von* DR SUCKOW in HEUSINGER'S *Zeitschr. f. organ. Physik.* II. Eisenach, 1828, s. 231—264, and further, F. STEIN, *Die weibliche Geschlechtsorgane der Käfer*, Mit IX. Kupfertaf, Berlin, 1847, 4to.

[3] C. PLINII, *Hist. nat.* Lib. VII. cap. 2.

[4] For instance, in *Bombyx dispar* by SCHAEFFER, in *Bomb. cratægi*, by ESPER (*Beobachtungen an einer neu entdeckten Zwitterphalæne*, Erlangen, 1778, 4to.) in *Vanessa urticæ*, by RAPP (OKEN'S *Isis*, 1833, s. 235), &c.

[5] As in *Scolia maculata*, by ROMAND, *Ann. des Sc. entomol.* IV. 1835, p. 191, in *Lucanus cervus*, figured in ASMUSS, *Monstruositates Coleopteror*, Riga, 1835, Tab. X.

individuals occur, which being incapable of propagating have been commonly considered to be sexless (the so-called *neuters*, working-bees, &c.) Even the external form indicates that they resemble rather the female than the male individuals, as the same is also indicated by their mode of life and their instinct directed to the care of the young ones. Anatomical investigation has confirmed this conclusion by demonstrating in the working-bees imperfect ovaries[1]. These individuals thus remain imperfect females, nurses, foster-mothers.

Observations are not wanting with respect to the development of Insects in the egg, although hitherto this subject has not been sufficiently investigated to allow a general representation of it to be offered. In eggs that are just laid, nay in those which lie at the lowest part of the oviduct and are the most mature, the germinal vesicle has disappeared; in eggs situated higher up in the oviduct it may be seen clearly with the germinal spot[2]. On the yelk is formed, from a union of cells, a layer as germinal membrane (*blastoderma*) which continues to grow so as to surround the entire yelk. The first rudiment of the embryo, the *nota primitiva*, lies on the ventral surface; the yelk lies on the dorsal surface, and becomes enclosed by the constantly growing ventral plates, without the formation of a special umbilical- or yelk-sac by constriction. The *stigmata* are developed only at a late period, and become open only shortly before the escape from the egg[3].

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[1] MADEM, JURINE in HUBER *Nouv. observations sur les Abeilles*, 2e édit. Paris et Genève, 8vo. II. Tab. XI. fig. 1, figure copied by RATZEBURG in his enquiries on this subject in *Nov. Act. Acad. Cæs. Leop. Car.* Vol. XVI. Pl. II. Tab. 47.

[2] See the microscopic representation of an egg-tube from *Agrion*, by R. WAGNER, *Abhand. der mathem. physic. Klasse der Akademie in München*, Bd. II. fig. 1; see s. 558.

[3] On the development of insects in the egg there are some observations of SUCKOW, *Anatomisch-physiologische Untersuchungen der Insecten und Krustenthiere*, Heidelberg, 1818, 4to. mit Kupf. s. 19, 23, 35 (eggs of *Bombyx pini*); also short, but interesting communications by RATHKE, on *Blatta germanica* in MECKEL'S *Archiv.* 1844, s. 27—37, Taf. II. (here there is on each side of the abdomen in the *embryo*, behind the attachment of the third pair of feet, a pediculated disciform organ which is, perhaps, a temporary respiratory organ to be compared with the gills of larvæ of salamanders; there are only four Malpighian vessels, which are increased in number after birth), and finally, by KOELLIKER (on *Chironomus, Simulia, Donacia*) *Observationes de prima Insectorum genesi Diss. inaug. Adjectæ sunt* III. *Tabul.* Turici, 1842, 4to. The numerous plates of HEROLD in his *Disquisitiones de Animalium vertebris curentium in ovo*

Most Insects quit the egg in a form entirely different from that which they afterwards possess. An impregnated female butterfly, for instance, deposits eggs, from which caterpillars proceed, which present not the slightest external resemblance with the mother. They are vermiform creeping animals, provided with different pairs of feet, which eat enormously, grow rapidly, cast their skin often, and at the last casting change into quite another creature, with a very hard and horny skin, which has no limbs, does not move from its place[1], takes no food, and falls as into a death-sleep. There may however be generally discerned in the seemingly formless mass, on close observation, the external parts of the butterfly, which folded and rolled together are concealed beneath the horny shell, on whose surface they are traced out. After a longer or shorter time, sometimes only after many months, the perfect insect, the butterfly, quits its narrow cell. At first the wings are short, moist and unfit for flying, but soon unfold themselves, become dry, and then support the flapping Insect through the air, which soon fulfils its new destiny, the propagation of its kind, and dies[2].

In these changes of form (*metamorphoses*) of Insects the first form or first state is called that of the *mask* or *larva*, and the Insects are then named caterpillars, maggots, &c. The second state is that of *nymph* or *pupa* (in day-butterflies called also *chrysalis*). The third state is that of the *perfect insect* (*insectum declaratum*, *imago*).

All Insects do not pass through this threefold state. The wingless hexapod Insects, with few exceptions, leave the egg in the same form which they afterwards retain; only the rings and the feet become more numerous in the *Myriapoda*. These Insects LATREILLE names Insects without metamorphosis. No winged Insect, on the other hand, comes from the egg with wings; but

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*evolutione* (*De generatione Insectorum in ovo*), Francof. ad Mœn. folio, Fasciculi II. (not completed), relate principally to *Musca vomitoria* and some *Lepidoptera*, but do not give so much information as might have been expected from the diligent and patient investigations of the author.

[1] If the pupa be however in such a situation that the perfect insect would not be able to come out of it (in the branch of a tree, for instance), then it changes its place towards the period of the last change, by pushing on its body by contraction, a motion assisted in many cases by little hooks on the rings of the abdomen.

[2] Sometimes the perfect insect, shortly after its coming forth, once more changes its coat, as is commonly known of the *Ephemera*.

amongst the winged there are many, which undergo no other metamorphosis than that they obtain wings. Their *larvæ* resemble the perfect Insect, but are quite without wings: the *pupæ* have rudiments of wings and move themselves: in the last moulting these wings become developed and perfect. These Insects undergo accordingly an *imperfect metamorphosis* (*demi-metamorphose* LATREILLE, *metamorphosis incompleta*); this is the case, for instance, with the grasshoppers. Most winged Insects, lastly, are subject to a *perfect metamorphosis* (*metamorphosis completa*), as we have described it in butterflies; the pupa takes no food, and remains in a state of rest or slumber. The pupæ of flies are entirely motionless, surrounded by a hard shell, and shew no limbs of the perfect Insect concealed beneath it; this shell is formed by the dried integument of the larva. Such a pupa is named *pupa coarctata*. In other dipterous Insects and in the *Lepidoptera* there is a hard elastic membrane, surrounding the enclosed compressed external parts of the future perfect Insect, and so disposed that they can be distinguished through the covering. Such a pupa is named *pupa obtecta;* such pupæ move the rings of the abdomen. In still other instances the wings and feet are free, without being surrounded by a common covering, as in the pupæ of beetles and bees[1].

These changes are not confined to the external parts; in the internal structure also very remarkable changes occur. The intestinal canal is in most larvæ straight, and consists principally of a wide stomach. The œsophagus and the part of the intestinal canal behind the stomach are longer and narrower in the pupa and in the perfect Insect, since the stomach contracts and is more definitely separated from the rest of the intestine. The nervous system becomes

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[1] For *pupæ* of the last kind the word *nympha* is sometimes specially used; see SWAMMERDAM, *Bibl. nat.* pp. 10, 16; BLADH, *Fundamenta Zoologiæ*, in LINN. *Amœnitat. Acad.* Tom. VII. p. 151; NEWPORT in TODD'S *Cyclop.* II. 879.

LINNÆUS names a pupa *complete* (*pupa completa*), which moves itself, and in all respects resembles the perfect insect; *half-complete* (*semi-completa*), that which is at rest and takes no nutriment. *Syst. nat.* Ed. 12, I. p. 534. FABRICIUS transferred these names improperly from the pupa to the metamorphoses, and thus named complete metamorphosis (*metamorphosis completa*), that which, in fact, is no metamorphosis, as in the myriapods, the spiders, &c. The metamorphosis which LATREILLE names complete (*ex. gr.* that of butterflies, beetles) FABRICIUS names incomplete (*incompleta*); the semi-metamorphosis bears with him the name of *metamorphosis semi-completa:* See FABRICIUS, *Philos. Entom.* p. 56.

tortuous in the pupa, and shorter in the perfect Insect; the nervous ganglia become less numerous, from some of them first approximating to each other and afterwards coalescing, whilst others entirely disappear; the first ganglion especially, which is situated in the head, increases in amplitude. The sexual organs, of which the germs already existed in the larvæ, become developed as well in respect of complex structure as of size. In the pupa new organs also come to view, of which before there was no trace, such as the wings, which are seen folded and rolled together internally at the thorax. The dorsal vessel undergoes less change than most of the other organs.

There is in larvæ, moreover, a peculiar fatty mass present, of which we have already spoken above; the secretion of this fat constantly increases, the nearer the larva approaches the condition of pupa; in this condition the fat is consumed again, and in that of the perfect Insect, when it also takes food, fat is no longer secreted.

The fatty secretion is thus obviously necessary to supply nutriment to the pupa, and to afford the material for the development of the organs of the perfect Insect. Yet the pupæ of Insects which undergo a complete metamorphosis, take, as stated above, no food, and are in connexion with the external world through respiration alone[1]. The condition of pupa therefore may be compared with that of hybernating animals, which are very fat in the autumn, during their sleep take nothing, and in the spring come out of their retreats in a very emaciated condition. The larvæ of Insects eat more than is necessary for their own growth; they are therefore usually inactive; deficient motion and superfluous food favour, as is known, the secretion of fat[2]. The reason why in perfect Insects no more fat is secreted, is found as well in the development of the sexual functions as in the greater activity of life and rapidity of motion, which are peculiar to them.

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[1] On this account they lose in weight. This loss is, however, at first very small, and only becomes remarkable on the approach of the last change. See NEWPORT in TODD'S *Cyclop.* II. pp. 879, 880.

[2] That this fat is not necessary for the life of the larva, is shewn by the examples of caterpillars in which ichneumons have deposited their eggs; the larvæ from these consume the fat of the former, which die from the robbery of their stock of food only at the time they should change into pupæ, or have changed.

We see therefore in the perfect Insect the manly period of their life: in the larva the childish period. Between the two nature has interposed a deep sleep of development. The marriageable period is deadly for many. There are also many difficulties to be overcome[1]. Some organs must for a time stand still, others (as for instance, the silk-secreting tubes of caterpillars) must entirely disappear. The development of the sexual organs is essential, and for that everything must wait awhile; these remain during the larval state behind other organs; now they repress in turn by their development the activity of other organs. Finally, the perfect Insect comes forth, in many respects a new creature. This is the true object of the phænomena, of which the metamorphosis is composed, which is not so entirely unique in its kind, as might be at first supposed. The perfect Insect lives for propagation, and when it has attained that purpose of its being, it dies to make room for others, and serves for food to birds and other animals. Thus also an annual plant ceases to grow as soon as its bloom is developed, and dies when the seed is come to maturity[2].

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[1] Every casting of the skin is connected with more or less of danger; the moulting is also a distressing season for birds; but especially the last shedding, when caterpillars are changed into pupæ, is frequently fatal. Sometimes the casting is incomplete; the head of the caterpillar remains attached to the pupa. In this way may be explained the occasional occurrence of butterflies with caterpillars' heads. See O. F. MUELLER, *Description d'un papillon à tête de Chenille, Mém. présentés à l'Acad. des Sc. de Paris*, 1774, VI. pp. 508, &c., *Naturforscher*, XVI. 1787, s. 203—212, Tab. IV. f. 1, 2; WESMAEL, *Ann. des Sc. nat.* sec. Série. Tom. VIII. 1837, *Zoologie*, pp. 191, 192; BRUINSMA, *buitengewone afwijkingen, waargenomen bij de gedaanteverwisseling des zijdeworms, Tijdschr., voor natuurl. Gesch. en Physiol.* VII. 1840, pp. 257—270, Pl. IV. and my *Aanteekeningen* thereon, *ibid.* pp. 271—275. Somewhat different are other observations of MAJOLI in *Bombyx mori*, in which the moths, without having first become pupæ, appear to have proceeded immediately from the caterpillars. MECKEL'S *Archiv für die Physiol.* II. 1816, s. 542.

[2] What is said here relates especially to the complete metamorphosis; in the incomplete the changes are less important. Comp. on this subject RENGGER'S *Physiol. Unters.* s. 49—87, and HEROLD'S *Entwickelungsgeschichte der Schmetterlinge*, Casel u. Marburg, 1815, 4to, (one of the most excellent works on Natural History which have been published in this century), in the numerous plates of which the development may be followed without a break in the whole and in all its steps. Comp. further, on the changes which the intestinal canal undergoes on metamorphosis, DUTROCHET, *Journal de Physique*, Tom. LXXXVI. 1818, p. 130, &c., and in MECKEL, *Archiv f. d. Physiol.* IV. Bd. 1818, s. 285—293; and on the changes in the nervous system, NEWPORT, *Philos. Trans.* 1832, II. pp. 383—398, Pl. XII. XIII.

The reproductive power in Insects which undergo metamorphosis is wanting in their perfect state; but if at an earlier period in the state of larva they have lost a foot, it grows out again at the next moulting, and is more or less perfectly restored. Also in the *Myriapoda* excised antennæ grow again[1].

The nervous system of Insects has for central part a row of ganglia of different number, which are usually connected with one another by two threads that are often very intimately united. This row of ganglia is situated on the ventral surface beneath the intestinal canal in the mid region of the body; the first ganglion however lies in front of and above the œsophagus, and there arises, by reason of the two threads which connect it with the second ganglion, a ring which surrounds the œsophagus. The greatest number of ganglia is found in the *Myriapoda*, eighteen in *Lithobius* (*Scolopendra forficata*), twenty-three in *Scolopendra morsitans*. In the larvæ of butterflies thirteen are counted, but ordinarily they are less numerous in the hexapod Insects. Large ganglia are situated in the thorax, and in some there are none in the abdomen, but two nervous strings alone, sometimes close together, sometimes separate from each other, as in *Nepa* and *Cicada*. From the ganglion above the œsophagus (*ganglion cerebrale*) arise the nerves of the eyes and antennæ; this ganglion lies transversely on the œsophagus, formed of two oval or somewhat conical lateral portions with their broad part turned to each other; the inferior surface is somewhat concave, the upper convex. The second ganglion, the first of those beneath the intestinal canal, is by some writers compared to the *cerebellum*, by others, on better grounds, with the *medulla oblongata;* the nerves that arise from it proceed to the oral parts, and perhaps correspond to the different branches of the fifth pair in vertebrate animals. Earlier writers, as ACKERMANN, REIL and BICHÂT, thought that the abdominal cord of Insects might be compared with the *nervus sympathicus* of vertebrate animals; CUVIER and GALL, on the contrary, have disowned and rejected this correspondence. It is necessary in this inquiry to determine in the first place what character is to be considered of sufficient value to distinguish the spinal cord from the

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[1] NEWPORT made experiments on *Iulus*, *Lithobius* and caterpillars of butterflies. See *Phil. Trans.* 1844, p. 283. In *Phasma* sometimes one foot is less than the rest, being a new growth. I found this once also in *Reduvius personatus*.

system of the great sympathetic nerve. It is impossible to recognise the position on the dorsal surface as such a character; for the reversed position of the heart in the invertebrate animals might lead us rather to expect that that of the central nervous system would be reversed also. The peculiarity of the sympathetic system, amongst other things, consists in this, that it supplies nerves which are distributed to parts not subject to the will. But since from the ganglionic cord in Insects the nerves of the organs of sense and the nerves of the voluntary muscles arise, there is no reason for comparing it to the sympathetic nerve. The ganglia therefore of this cord are to be considered as an union of the ganglia of the spinal nerves of the two sides[1]. This view would seem to receive more support when we reflect, that the spinal ganglia belong to the uppermost (the posterior) or the sensitive roots of the spinal nerves, and that in Insects two strings have been discovered in each connecting band between the ganglia, of which the undermost alone is connected with the ganglia, whilst the uppermost merely passes with its fibres over the ganglion[2]. That here the uppermost and not the undermost string, as in the spinal cord of vertebrate animals, is related to motion, is to be explained by the reversed position of the nervous system. The similarity becomes obvious when we thus consider the matter, that in Insects as well as in vertebrate animals the motor strings are placed towards the interior, the sensorial nearest to the surface. It is, however, perhaps more prudent not to pursue this analogy too far. With these uppermost strings we must not confound the system of *transverse nerves* which LYONET described long ago in the caterpillar of the Willow-hawk under the name of *brides épinières*[3]. These are situated a little in front of each ganglion, pass transversely over the straight muscles which lie lengthwise on the ventral surface, and are distributed by their branches to the muscles and especially to the air-tubes and the dorsal vessel. A longitudinal,

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[1] G. R. TREVIRANUS, *Biologie*, v. s. 331, 332; E. H. WEBER, *Anat. comparata nervi sympathici*, Lips. 1817, p. 95.

[2] This important discovery of NEWPORT, who was incited to it by C. BELL, the celebrated discoverer of the distinction of the motor and sentient roots of the spinal nerves, may be seen, illustrated by figures, in *Phil. Trans.* 1834, Pt. 2, pp. 406—410.

[3] *Traité anat. de la Chen.* pp. 98, 201, Pl. IX. figs. 1, 2. NEWPORT has very accurately investigated this nerve in *Sphinx Ligustri*, *Phil. Trans.* 1836, Pt. II. pp. 544, 545, Pl. XXXVII. (This figure is transferred to TODD'S *Cyclop.* II. p. 987.)

single nerve, lying above upon the strings of the ganglionic nervous system, connects each plexus with the following one. In perfect Insects this system is less distinctly visible, and often is completely combined with the rest of the nervous system[1].

There is found in addition still another nervous system in Insects, destined especially for the organic life, which was made known in part by the investigations of SWAMMERDAM and LYONET in former times, and described by the last under the name of *nerf recurrent*[2], and to which in our century JOH. MUELLER has by his investigations especially directed the attention of anatomists. It has been compared by him and by most modern writers to the sympathetic nerve of vertebrate animals, by others to the *nervus vagus*. This system of nerves consists of a single middle portion and of two lateral portions. The single portion arises from one or more nervous ganglia situated in the head, which are connected with the most anterior part of the first (the cerebral) ganglion of the ganglionic cord. From this single portion whilst situated in the head nerves arise for the uppermost oral organs, and a thread which runs along the œsophagus on the dorsal surface to the stomach, and at its extremity terminates in a ganglion. In *Phasma ferula* BRANDT saw numerous branches arising transversely, and running in arches over the œsophagus and stomach to form a fine nervous net. Perhaps a similar distribution may be suspected in other Insects, where the extreme delicacy of the nervous branches does not permit their determination. In most Insects the middle single portion is the most developed; in *Gryllotalpa* and *Gryllus*, on the contrary, the lateral portions are more developed than the single and middlemost. The lateral portions consist ordinarily of two pair of ganglia that lie close together behind the cerebral ganglion, of which the anterior is connected with the cerebral ganglion by one or two fine nervous threads. From these ganglia delicate nervous branches arise which run to the œsophagus whilst they are also in connexion, by fine threads with the single middle nerve that runs over the œsophagus[3].

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[1] Besides the authors cited comp. also especially an excellent paper on the nervous system of Beetles by E. BLANCHARD, *Ann. des Sc. Natur.*, 3ième Série, Tom. v. *Zoologie*, 1846, pp. 273—379, Pl. 8—15.

[2] *Traité anat. de la Chen.* pp. 413, 578, &c.

[3] Comp. JOH. MÜELLER, *Ueber ein eigenthümliches dem Nervus sympathicus analoges*

Of the organs of sense of Insects the eyes are best known. We have already spoken above (p. 249) of the distinction between simple and compound eyes. The simple eyes have a crystalline lens and a vitreous humour. The cornea, on which the crystalline lens lies, without being separated from it by an aqueous humour, is formed by the common horny integument of the body, which at that part is raised convexly and is more transparent. The vitreous humour is surrounded by a black pigment of the choroid. The compound eyes, always two in number, present a cornea which is divided into many façettes, ordinarily hexangular. Each of these divisions has the form of a small, usually biconvex lens. Behind them lie an equal number of transparent pyramids or conical bodies which are turned by their base to the cornea and by their apices approach each other inwards[1]. Lastly, there is a nerve at the apex of every cone; the optic nerve in fact divides into as large a number of branches as there are divisions of the cornea. A dark-coloured pigment, often violet or blackish brown, separates the nervous fibres and the transparent cones, especially at their pointed extremities, from each other. At the base of the cones, beneath the cornea, there is frequently a pigment of a different and more lively colour; hence arises the metallic splendour of the eyes in some Insects, as in *Hemerobius* and *Chrysops*, which however disappears after death. No eyelids are present in Insects, but between the façettes of the cornea there are found in certain *Hymenoptera* and *Lepidoptera*, here and there, some hairs, which ward off substances from the eyes and defend them. Surrounding

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*Nervensystem der Eingeweide bei den Insecten, Nov. Act. Acad. Cæs. Leop. Car.* Tom. XIV. P. I, 1828, pp. 71—108, Tab. VII. IX., and J. F. BRANDT, *Bemerkungen ueber die Mundmagen- oder Eingeweidnerven der Evertebraten, Mém. de l'Acad. des Sc. de St. Pétersb.* (VI. Série, Tom. III. 2, *Sciences nat.*) published separately, Leipzig, 1835, 4to, with III. plates; also in French in the *Ann. des Sc. nat.* 2e Série, Tom. V. 1836, *Zool.* pp. 81, &c. and 138.

[1] WILL considers these cones, which MUELLER compares to the vitreous humour, for the most part as crystalline lenses, and supposes that behind them there is still a vitreous body with concave anterior surface to be found. In *Sphinx Atropos*, where these cones are very large, (I found them one-seventeenth Par. lin. long,) I have several times observed the separation pointed out by WILL at the posterior extremity of the cone. In other insects the cones are so short, that the separation, even if it be present, cannot well be perceived, whilst even on that account TREVIRANUS thought there was reason to suppose that in some insects the cones in question were absent in their compound eyes. *Erscheinungen u. Gesetze des organ. Lebens* II. 1, Bremen, 1832, s. 77.

the eyes are large air-sacs or wide air-tubes, from which fine branches arise, which in part run to the pigment and connect its granules, in part pass into blind cylindrical tubes situated between the nerve-threads of the vitreous cones[1].

De la Hire, who first discovered the simple eyes of Insects, thought he might conclude from their presence, that the larger (compound) eyes were not organs of vision. That they also serve for vision the experiments of Swammerdam, who smeared them in flies with black varnish, have proved. Réaumur also did the same with bees. It is more difficult to determine exactly in what respects the office of the compound and simple eyes differs, although the last probably serve principally for seeing near objects. The bees, in which Réaumur had smeared these eyes with a dark varnish, whilst their compound eyes remained uncovered, could not find their hives[2]; moreover all flying Insects are invariably provided with compound eyes. There are Insects which have simple eyes alone, as the *Myriapoda* and *Parasitica* (also the larvæ of the *Lepidoptera*); few Insects are entirely without eyes, like a parasitic Insect of bees (*Braula* Nitzsch[3]), and a new genus of the *Carabici*, *Anophthalmus* of Schmidt[4], and different *Myriapoda*. In the diurnal butterflies and most *Coleoptera*, there are two compound eyes alone, without simple eyes; simple eyes are also wanting in certain *Diptera*, in *Forficula*, *Blatta* and other *Orthoptera*, in many *Hemiptera*; where they occur in company with compound eyes, usually three are present, sometimes, as in *Castnia*, *Sesia*, *Noctua*, *Gryllotalpa*, two[5].

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[1] See on the compound eyes of insects amongst others Hooke, *Micrographia*, Londini, 1667, Tab. 24, Swammerdam, *Bibl. nat.* pp. 487—498, Tab. xx., J. Mueller, *Zur vergl. Physiol. des Gesichtsinnes*, Leipzig, 1826, 8vo. s. 307—390; by the same, *Fortgesetzte anatomische Untersuchungen ueber den Bau der Augen bei den Insecten u. Crustaceen*, in Meckel's *Archiv*, 1829, s. 38—64, and *Ueber die Augen des Maikäfers*, *ibid.* s. 177—181; F. Will, *Beiträge zur Anat. der zusammengesetzten Augen*, Leipzig, 1840, 4to; A. Brants on the air-tubes in the compound eyes of the *Articulata*, *Tijdschrif. voor nat. Gesch. en Physiol.* xii. 1845.

[2] *Mem. p. servir à l'Hist. des Ins.* v. pp. 287—289.

[3] Germar, *Magazin der Entomol.* iii. 1818, s. 314.

[4] See Jac. Sturm, *Deutschland's Insecten* xv. 1824, pp. 129—137, Taf. 303. Also a genus of the *Xylophagi*, *Anommatus terricola*, Robert, *Acad. roy. de Bruxelles*, 1836.

[5] Klug, *Ueber das Verhalten der einfache Stirn und Scheitelaugen bei den Insecten mit zusammenges Augen. Physikal-Abhandlungen der Königl. Akad. der Wissensch. zu Berlin, aus den Jahre* 1831, s. 301—312.

For touch, in some Insects the sucker serves as the organ; in others the palps which belong to the organs of the mouth, in many the antennæ. Of taste, smell and hearing, little is known. Taste has its seat in the internal surface of the mouth. In some Insects there is a part present, which may be compared to a tongue[1]. Respecting smell different opinions are offered. On theoretical grounds, from presumed analogy with vertebrate animals in which the first pair of cerebral nerves always goes to the olfactory organ, BLAINVILLE has concluded, that the antennæ, to which the first nerves from the cerebral ganglion proceed, must be the organs of smell[2]. BASTER, REIMARUS, DUMÉRIL and STRAUS place the sense of smell in the air-slits (*stigmata*), which admit the external air to the air-tubes. TREVIRANUS however has with reason alleged against this opinion, that the *stigmata*, inasmuch as they are dispersed over the body, must be useless for determining the place from which the odorous matter proceeds; also that in Insects, which have no *stigmata* and which respire by tracheal gills, it would be difficult thus to account for the sense of smell. ROSENTHAL discovered in flesh-flies (*Musca carnaria*) a red-brown, folded membrane, which is situated in the head beneath the setting on of the antennæ[3]. TREVIRANUS thinks that in sucking Insects, which are especially distinguished by their acute sense of smell, the seat of this sense ought to be sought for in the sucking organ itself, or in the œsophagus. If these animals suck in air, then they may smell with the same organ, by means of which, when they imbibe fluids,

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For the theory of vision with compound eyes it is necessary that the partial images be erect; hence JOH. MUELLER (*Zur vergl. Physiol. des Gesichtsinnes*) has concluded that insects see with their compound eyes not by refraction of the rays, but by keeping separate the rays of light that come from different points. Hence he denies to the façettes of the cornea, which are true lenses, a refractive power; yet that vision in insects with compound eyes occurs by dioptric means, has been shewn by Dr. A. BRANTS, and established by means of an instrument constructed on the plan of the insect's eye. *Tijdschr. voor natuurl. Geschied. en Physiol.*, XD., 1840, pp. 12—56, Pl. I.

[1] See this part figured and described in some hymenopterous insects by G. R. TREVIRANUS, *Verm. Schriften* II. s. 125, 131—133, Tab. XIII. fig. I, L, fig. 4, 7; Tab. IV. fig. 5, 7, 8, 9, L′ and L.

[2] See DUGÈS, *Physiol. compar.* I. 1833, pp. 157—161, who endeavoured to establish the same views by experiments, as also LEFEBVRE, *Ann. de la Soc. entomol. de France*, 1838.

[3] REIL'S *Archiv f. die Physiol.* X. s. 427—439.

they taste. An observation of HUBER respecting bees pleads for this opinion. Bees are very averse to oil of turpentine; these insects were not, however, repelled when HUBER brought a pencil dipped in it to the air-slits and other parts of the body, but flew away as soon as he approached it to the mouth. LESSER had already noticed that flesh-flies, whose eyes had been smeared with oil of turpentine, still flew to tainted meat, but not so when their snout had been smeared with it[1]. In Insects that do not suck the seat of smell is probably at the beginning of the œsophagus also[2].

Just as uncertain are we respecting the auditory organ of Insects, although it was known to the ancients that they have hearing[3]. Of this sense also several writers, and lately NEWPORT[4], have sought the seat in the antennæ. Yet the experiment that grasshoppers, when their antennæ have been cut off, continue to hear, is even less favourable to this opinion, than is the presence of hearing in spiders that have, as is known, no antennæ[5]. RAMDOHR thinks that bees hear by means of their mandibles; TREVIRANUS thinks that he has discovered in *Blatta orientalis*[6], in *Libellula* and in bees, and BLAINVILLE in *Cicadæ*, a special auditory organ[7]. When we remember that for an auditory organ in its simplest form nothing more is required than a nerve specifically receptive of undulations of sound and so expanded that such undulations may be conducted to it by means of the hard covering of the body, it is

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[1] The secretion of *Stapeliæ*, which resembles putrid flesh in smell, deceives flesh-flies into laying their eggs on the flowers (see ROESEL, *Ins.* II. *Muscar. et Culic.* Tab. IX.); a clear proof that the instinct of these animals is influenced more by smell than sight.

[2] G. R. TREVIRANUS, *Verm. Schr.* II. s. 146—155, *Biologie*, VI. s. 307—318, *Erscheinungen u. Gesetze d. organ. Leb.* II. s. 141.

[3] See for instance, on bees, ÆLIANI *de Animalium nat.*, L. V. c. 13. Of the moderns BRUNELLI amongst others has proved hearing in Crickets by interesting experiments; *Comm. Acad. Bononiens.* VII. 1791, pp. 199, 200.

[4] TODD'S *Cycloped.* II. pp. 892, 961.

[5] M. G. C. LEHMANN, *De Antennis Insectorum Dissertatio posterior*, Londini et Hamburgi, 1800, 8vo. pp. 45—47.

[6] In *Blatta orientalis* there is on each side of the head, behind the base of the antennæ, a white spot, formed by a round membrane, under which portions of the first nervous ganglion are immediately situated, TREVIRANUS, *Annel. der Wetterauischen Gesellschaft*, I. s. 169—171, Taf. V. figs. 1—3. BURMEISTER thinks these white spots are rudiments of simple eyes.

[7] Comp. TREVIRANUS, *Biolog.* VI. s. 358—360; BLAINVILLE, *De l'organisation des Anim.* 1822, I. p. 565, &c.

readily seen, that it is not very possible in all cases to determine by anatomical investigation the situation of this organ. VON SIEBOLD not long ago thought he had discovered in *Orthoptera* an auditory organ which is not in the head. In *Locusta* there are on the *tibia* of the first pair of feet two oval apertures, covered by a tense membrane, which DE GEER[1] had already figured. Behind this there is a vesicular expansion of the air-tube of the fore-feet and at its anterior margin a nerve, which coming from the first thoracic ganglion, spreads out into a band-like swelling in which oval, granular bodies, together with long pediculated, remarkable rods, are contained. In *Acridium* and *Truxalis* there is situated in the first segment of the abdomen, on each side above the third pair of feet, a tense membrane, behind which there is a vesicle filled with a clear fluid: this vesicle is surrounded by an air-sac, and to it there runs a nerve from the third thoracic ganglion, which is also swollen, and in the swelling exhibits similar rod-like bodies to those which in *Locusta* occur in the nervous swelling of the fore-feet.

There still remains something to be said by us respecting the organs of motion in Insects. The antennæ of insects are attached to the horny covering of the body, which forms an external framework, a dermal skeleton. This ought not on that account, as has sometimes happened in consequence of incorrect and confused notions, to be put on a par with the skeleton of higher animals; for the bones or cartilages which form the framework of vertebrate animals belong for the most part to the neural skeleton, that is, the most essential and central parts that compose the column of the vertebral skeleton protect the spinal cord and brain and separate them from the rest of the body[2]. Yet there are parts present in Insects which

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[1] For a more detailed description I refer to the observations of VON SIEBOLD himself in ERICHSON'S *Archiv für Naturgesch.* 1844, s. 52—81, Taf. I. With every consideration for SIEBOLD'S great merits in the anatomy of the lower animals, I venture to express modestly my doubts that in insects organs of sense can occur in such an unusual situation. The eyes on the margin of the mantle in *Pecten* and *Spondylus* afford little support to this view, inasmuch as the *type* of the *acephalous* molluscs, has just as little claim to the possession of a head, as that of the *Acalephæ* and *Echinodermata*.

[2] It is a merit of CARUS well deserving of acknowledgement, that he recognised and clearly defined the difference between the dermal, the visceral and the nervous

may be looked on as the rudiments of a neural skeleton. There is in each division of the thorax a process, which often has the form of the letter Y, supports the nervous cord, and by the expansion of its two branches, which are directed upwards, partly covers it. To this process AUDOUIN has given the name of *Entothorax*; it is even found in the head and sometimes in the first abdominal ring. These are the same processes which TREVIRANUS had already compared to vertebræ[1]. These vertebræ, however, are not joined together to form a spine, but are separated from each other by certain spaces. The dermal skeleton of Insects consists of a peculiar substance to which ODIER gave the name of *Chitine*, LASSAIGNE that of *Entomoline*[2], which occurs also in the integument of *Arachnoïdea* and *Crustacea*, and which is not soluble in caustic potass, neither is rendered yellow by nitric acid, like corneous tissue. It burns without fusion or intumescence. It forms different layers of which the most external is composed of irregular cells[3].

The arrangement of the muscles is different in the different orders of Insects, nay, in the same insect in its different states, if it undergoes complete metamorphosis. The difference between the muscles of the thorax and of the abdomen, which in the perfect insect is so marked, is absent in the vermiform elongated larva, for instance, in caterpillars. Along the dorsal and ventral surface riband-like muscles run longitudinally; there are different oblique muscles in addition. The muscles present in their bundles transverse stripes, as in vertebrate animals[4]. They are usually

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skeleton; see especially his excellent work *Von den Ur-Theilen des Knochen- und Schalen-Gerüstes*, Leipzig, 1826, folio.

[1] *Verm. Schriften*, IV. s. 229, 230.

[2] See ODIER, *Mem. de la Soc. d'Hist. Nat. de Paris*, I. 1823, pp. 29—42, and the later investigations of C. SCHMIDT, *Zur vergleichenden Physiologie der Thiere*, Braunschweig, 8vo. s. 32, 52.

[3] Comp. H. FREY and R. LEUCKART in the new edition of R. WAGNER, *Lehrb. der Zootomie*, revised by them, 1845, pp. 3—5; also H. MAYER in MUELLER'S *Archiv*, 1842, s. 12—16. In the skin of the Silkworms and their pupæ (and also in other pupæ of *lepidoptera*) there are found *stellate* cells, which PLATTNER compares with the bone-corpuscles in the osseous tissues of vertebrates, MUELLER'S *Archiv*, 1844, s. 46, 47.

[4] Since in every ring of the *Larva's* body the same arrangement of the muscles is observable, the number of the muscles, when those of all the rings are counted together, is very great. LYONNET found in the larva of the Willow-hawk more than 4,000 muscles.

white, sometimes pale red or brown-yellow, and are not surrounded by a fibrous membrane, so that, when detached from their insertions, they may be spread out like a pencil.

Many insects are distinguished by special art-instincts, by their cunning in overpowering their prey, by the care for their eggs or young, by the construction of artificial habitations, &c. Their field of observation is greatly extended by the high development of their visual organs. The faculty of indicating beforehand changes of the weather by certain actions, by which some insects are distinguished, rests probably on their finer sense of the different conditions of the atmosphere, since the air penetrates their whole body by the tracheæ. In this respect, as in so many others, they resemble birds amongst vertebrate creatures, whose air-sacs and hollow bones are in connexion with the respiratory organs, and in which also a perfect correspondence between the external atmosphere and the internal parts of the body is thus maintained.

Manifold is the damage which Insects occasion to us, as well by spoiling our luxuries, as by injuring or annihilating our property. On the other hand they procure for us many advantages, amongst which I need only name silk, wax and honey. But much more important still is the use they supply in the great economy of nature, and therefore indirectly to us[1]. The injury which they sometimes cause us, is not only more than counterbalanced by these benefits, but is for the most part only a consequence of the beneficent action itself. It is these small animals that nature employs for her great purposes, and which effect by their numbers what the largest animals working separately are unable to perform. Hence they are less dependent on the will of man, which indeed here and there may be able to destroy a species, but is unable to exterminate it throughout entire districts, as it has annihilated different mammals in lands which they formerly inhabited. Insects maintain the due equilibrium in the vegetable kingdom, diminish putrefaction, and lastly afford to many other animals, especially birds, an abundant and ever present nutriment.

The geographical distribution of Insects opens a wide field for inquiry, which however has only been lately entered. Many families,

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[1] On the benefit and the injury caused by Insects, see in detail KIRBY and SPENCE, *Introduction to Entomology*, I. pp. 80—338.

nay, whole orders of insects, have been collected in other parts of the world with more or less of inadvertency by travellers and collectors, or at least not with such care as to allow us to deduce from the species yet known any general rules. Thus, for instance, if we compare the number of *Diptera* found out of Europe with the European, and thus form a measure of the proportion which subsists between exotic and European species, we shall arrive at a conclusion which will certainly vary much from the truth. Some genera are proper to the warm regions of the earth alone, and in Europe are represented either not at all or only by a few species from the southern part of our quarter of the earth, as the *Cicadæ* (*Tettigoniæ* FABR.) and the genus *Phasma*. On the whole our knowledge of some orders of insects, especially of the *Hemiptera* and *Orthoptera*, would be very confined, were we to limit ourselves to European insects. The distribution of the same or very similar species in countries widely distant from each other, the remarkable richness of the same natural group giving a special character to *Faunæ*, often depends upon the same quality of the soil and a resemblance in the vegetation. Thus for instance the insects of the sandy regions of Asia near the Caspian Sea correspond to those of North Africa, nay even to those of the Colony at the Cape. A similar remark may be made in relation to the class of *Mammalia*. It is this remarkable abundance of certain forms which leads us at first sight, and even without having determined a single species, to distinguish a collection of insects from the Cape of Good Hope, for instance, from one from the Indian Archipelago; *Mylabris*, *Pimelia* (*Trachynotus*, *Sepidium*), *Brachycerus*, *Acrydium*, *Mantis*, &c. in the first, *Phasma*, *Pentatoma*, numerous resplendently coloured *Papiliones* in the second, give to the two a totally different appearance. Some species of insects are confined within very narrow limits; others, as for instance, *Papilio cardui*, *Plusia gamma*, occur in a considerable portion of the old world, and also in North America[1].—The limits of vegetation on mountains, as well as near

[1] On the geographical distribution of Insects comp. LATREILLE, *Introduction à la Géographie générale des Arachnides et des Insectes, Mém. du Muséum*, IV. 1817, pp. 37—67; the same in *Dict. Class. d'Hist. Nat.* VII. 1825, pp. 290—296, and especially LACORDAIRE, *Introd. à l'Entomol.* II. 1833, pp. 528—619 (the best hitherto known on this subject). See also C. G. REICH, *Beitrag zur Lehre von der geographischen Verbrei-*

the poles, are also usually those of the distribution of Insects; some species live even on snow and ice, as a small black insect from the order *Thysanura*, which some years ago (1839) was first discovered by DÉSOR on the glacier of *Monte Rosa*, and after him is named *Desoria glacialis*.

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*tung, der Insecten, insbesondere der Käfer, Nov. Act. Acad. Cæs. Leop. Car.* XVI. 2, pp. 805—840.

# SYSTEMATIC

# ARRANGEMENT OF INSECTS.

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## CLASS VIII.

## INSECTA.

ARTICULATE animals, with articulate feet. Head distinct, furnished with two antennæ. Heart situated in the back, similar to a longitudinal vessel. Organs of respiration tubular, branched, distributed throughout the whole body (*tracheæ*). Sexes distinct.

### SECTION I. *Apiropoda.*

With numerous feet. With thorax not separate from abdomen.

### ORDER I. *Myriapoda.*

Wingless. Feet numerous (24 or more), disposed according to the length of the body, terminated by a single claw. Two clusters of simple eyes, in various number; in some no eyes.

*Myriapods.* LEACH and other modern writers consider this order as a class, and wish the name of Insects to be restricted to six-footed articulate animals, of which the body consists of three principal parts: head, thorax, and abdomen. Here there is no separation between thorax and abdomen, but the whole body is parted into rings. The reason why we have placed these insects at the beginning of the class, is to be found in their resemblance to the ringed worms, to which they are related, not in their external form alone, but also in their internal structure; for even the six-footed insects, which undergo complete metamorphosis, often in the larval state approximate to the myriapods. We willingly admit, on the other hand, that the myriapods accord with certain Crustaceans, and even form an unconstrained transition to them. But this natural transition is in some degree broken by other insects, which on the

contrary pass through the order of the Parasites to the Arachnids. The Arachnids again conduct us by another road (through the genus *Scorpio* to *Limulus*) to the Crustaceans. Thus is the entire animal kingdom a net everywhere connected, and every attempt to arrange animals in a single ascending series must necessarily fail of success.

The oral organs consist in most of two mandibles, which are toothed at their broad extremity, and of a four-lobed underlip whose two lateral lobes represent the two lower jaws (*maxillæ*). In some the second pair of feet forms, by coalescence of their basal pieces, a sort of second underlip, which covers the oral organs and the first pair of feet from beneath. In certain species the jaws and the lip are represented by pointed organs which coalesce to form a sucker; but by far the greater number are manducating insects. Myriapods in the first period of their life have fewer rings and only three pairs of feet; as they grow new rings arise and the number of feet is augmented. In this respect also they resemble the ringed-worms, whilst in the metamorphosis of Insects the homologous parts, rings, segments, are not multiplied, but are developed unequally or are united, to form the different divisions of the body in the perfect Insect. The number also of simple eyes increases during the development of myriapods.

These Insects live in obscure places, under the bark of trees and on the ground under fallen leaves, stones, &c.

Comp. on this order amongst others: LEACH, *A tabular View of the external Characters of four Classes of Animals which* LINNÉ *arranged under Insecta, Transact. of the Linn. Soc.* XI. 1815, p. 306, &c. (pp. 376—386); P. GERVAIS, *Études pour servir à l'Hist. nat. des Myriapodes, Ann. des Sc. nat.* sec. Série, Tom. VII. 1837; *Zool.*, pp. 35—60; also, 3e Série, Tom. II. 1844, *Zool.*, pp. 51—80; J. F. BRANDT, *Recueil de Mémoires relatifs à l'ordre des Insectes Myriapodes (extrait du Bulletin publiée par l'Acad. des Sc. de St. Petersbourg*, Tom. V.—IX.) 1841, 8vo; A. F. WAGA, *Observations sur les Myriapodes, Révue zool. publiée par* GUÉRIN, Mars 1839, pp. 76—90; G. NEWPORT, *List of Myriapoda in the British Museum, Ann. of Nat. Hist.* XIII. 1844, pp. 94—101, pp. 263—270; C. L. KOCH, *System der Myriapoden*, Regensburg, 1847, 8vo min.

Family I. *Julidæ*. (*Chilognatha* LATR.) Anterior feet not changed into organs of manducation; rest of the feet in most of the segments bigeminal, slender, short, of the two sides approximate, inserted nearly at the middle of the abdomen. Antennæ short, filiform, with six or seven joints. Organs of copulation situated at the anterior part of the body.

Comp. J. F. BRANDT, *Tentaminum quorundam Monographicorum, Chilognatha spectantium Prodromus. Bullet. de la Soc. imp. des Naturalistes de Moscou*, VI. 1833, pp. 194—209. Tab. V.

Phalanx I. *Sugentes* (*Siphonizantia* BRANDT). Mandibles and maxillæ coalesced to form a tube. Body elongate, narrow.

*Polyzonium* BRANDT, *Platyulus* GERV. Two series of three small eyes in the frons.

Sp. *Polyzonium germanicum, Platyulus Audouinianus* GERV., KOCH in PANZER'S *Deutschl. Insecten, fortgesetzt von* HERRICH SCHÆFFER, Heft 190, No. 17.

*Siphonotus* BRANDT. Two distinct eyes in middle of frons.

*Siphonophora* BRANDT. Eyes none.

Phalanx II. *Manducantes* (*Gnathogena chilognatha* BRANDT).

A. Middle segments of the body formed of a single complete ring, to which the feet are inserted in the sides of the abdominal protuberance. *Monozonia* BRANDT.

*Pollyxenus* LATR.[1] Body soft, with segments not numerous, with hairs or scales elongate, pinnatifid, fasciculate, set on a tubercle at the sides, with the last segment penicillate. Eyes aggregated in two clusters.

Sp. *Pollyxenus lagurus, Scolopendra lagura* L.; DUMÉRIL, *Consid. gener.* Pl. 58, fig. 7; GUÉRIN *Iconogr. Ins.* Pl. I. fig. 5: this little animal lives under the bark of trees and in moss, and then attains a size of more than a line. In this species also DE GEER has observed the increase in number of rings and feet (*Mém. présentées à l'Acad. des Sciences de Paris*, I. 532; *Mém. pour l'Hist. des Ins.* VII. pp. 576—578. The full-grown insect has 12, or according to KOCH, 13 pairs of feet.

*Polydesmus* LATR. (species of *Julus* L.) Body covered with a hard skin, with segments produced at the sides, depressed.

*Polydesmus* LEACH. Eyes none. (Sub-genera *Tropisoma, Scytonotus, Platyrhœus, Polydesmus, Rhacophorus, Euryurus, Oxyurus, Fontaria* KOCH).

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[1] Some zoologists write *Polyxenus*, but we leave the word, of which the derivation is unknown to us, as LATREILLE wrote it; he wished to express by it *crafty* (*rusé*), (*Hist. nat. des Crust. et des Insect.* VII. p. 62), although as little of particular craft is known to us in this little animal, as of a Greek word agreeing with this name, which denotes *crafty*.

Sp. *Polydesmus complanatus*, *Julus complanatus* L., DUMÉRIL, *Consid. génér.* Pl. 57, fig. 2, DE GEER, *Ins.* VIII. Pl. 36, fig. 23; 8 lines long, 1 line broad; 31 pairs of feet. There are many foreign species of this genus; comp. BRANDT, *Bulletin scientifique de l'Acad. de St. Petersbourg*, Tom. v. and IX; *Receuil de Mémoires*, &c. pp. 125—141; NEWPORT, *Ann. of Nat. Hist.* XIII. pp. 265, 266; GERVAIS, GUÉRIN, *Magasin de Zool.* 1838. Pl. 240, fig. 1; (*Polydesmus margaritiferus* from Manilla), &c. In the male there are in the seventh ring of the body, on the ventral surface, two hook-like organs directed forward, and (behind them) only one pair of feet.

*Craspedosoma* LEACH. Eyes distinct. (Sub-genera *Craspedosoma*, *Chordeuma*, *Campodes* KOCH).

*Strongylosoma* BRANDT. Body covered with a hard skin, elongate, round. Eyes none.

B. Middle segments of the body composed of three parts, with the ring nearly complete at the dorsum and sides, and two middle ventral laminæ, one situated behind the other, in whose posterior margin the feet are inserted. *Trizonia* BRANDT.

*Julus* L. (exclusive of some species). Body elongate, cylindrical, covered with hard skin, with segments not marginate. Feet numerous.

Sub-genera: *Julus*, *Spirotrephon* BRANDT, *Spirotreptus* BR., *Spirocyclistus* BR., *Spiropœus* BR., *Spirobolus* BR., *Eurygyrus* KOCH, *Nemasoma* KOCH, *Blanjulus* GERV., (*Allajulus* KOCH, no eyes), *Lysiopetalum* BRANDT.

Comp. on the internal structure of these animals TREVIRANUS, *Vermisch. Schrif.* II. 1817, s. 39—47; SAVI, *Osservazioni per servire alla storia di una specie di Julus, Opuscoli scientif.*, Bologna, I. 1817, pp. 321—337. (*Julus communis* SAVI, *Julus varius* FABR.); SAVI *Osservaz. sull' Julus fœtidissimus* (*Lysiopetalum fœtidissimum* BRANDT), op. cit. III. 1819, p. 52; NEWPORT, *On the Organs of Reproduction and the Developm. of the Myriapoda. Phil. Trans.* 1841. Pt. II. pp. 99—130, (the article *Myriapoda* by RYMER JONES in TODD'S *Cyclopædia*, III. pp. 551—560, contains a full extract from it).

These Insects (the Myriapods) live principally on vegetable food; some also eat dead earth-worms and small molluscs. They diffuse, like many other animals of this family, an unpleasant smell which in some species is very powerful; it is caused by an unctuous fluid, with acid reaction (SAVI), which is secreted in small sacs or vesicles, of which there is a pair situated in each ring. TREVIRANUS erroneously supposed these vesicles to be respiratory organs, and their

apertures, which form a row on each side of the body, to be air-slits (*stigmata*). The true air-slits lie quite beneath, near the insertion of the feet, (SAVI op. cit. Tom. I. p. 334, BURMEISTER in OKEN'S *Isis*, 1834, s. 134—138. Taf. I.) These animals can roll themselves up spirally, with the head in the middle; in which posture they pass the winter. In copulating they bring the anterior part of the body in which the sexual organs are situated (in the female in the fourth, in the male in the seventh ring), perpendicularly upwards; the posterior part of the body rests tortuously on the ground. In the spring the female deposits her eggs in masses of sixty or seventy in a hole excavated for the purpose under the ground; after three weeks or more the young make their appearance, but still continue to adhere for some days by a string to the shell, which has burst longitudinally, without motion, and surrounded by a proper membrane; at that period they have no legs at all; as soon as they have got three pairs of feet, they separate themselves from the shell; they have now a great resemblance to the larvæ of some *Coleoptera*; soon the number of rings and feet begins to be increased in that part of the body which is seated in front of the penultimate ring.

*Sp. Julus sabulosus* L., KOCH in PANZER u. HERRICH SCHÆFFER *Deutschl. Ins. Heft 162, No. 7.* Some foreign species attain a length of five inches and more, as *Spirotreptus javanicus* BRANDT, and *Spirobolus spinosus* DE HAAN, *Mus. Lugdun. &c.* The last species, from New Zealand, is black, with different rows of spines running longitudinally.

*Glomeris* LATR. Body elongato-oval, gibbous above, plane or concave below, contractile into a ball, with the first segment made up of a small dorsal lamina, semicircular, the second broader than the rest, the last semicircular. Antennæ thick, with the sixth joint the largest.

A. Eyes on both sides eight; seven disposed in a curved line, the eighth on the outside, out of rank. Joints of antennæ seven, the penultimate including the last. Sub-genus *Glomeris* BRANDT.

Sp. *Glomeris limbata* LATR., *Glom. marginata* LEACH, DUMÉR. *Consid. génér.* Pl. 57, fig. 3, *Oniscus zonatus* PANZER, *Deutschl. Ins.*, Heft 9, No. 23, BRANDT u. RATZEBURG, *Medizin. Zool.* II. Tab. XIII. figs. 7—10. These animals resemble in external form some of the *Oniscinea* (*Oniscus, Armadillo*), and are even met with in apothecaries' shops, amongst the so-called *Millipedes*, mixed up with *Armadillo officinarum*. Comp. on the anatomy of this insect BRANDT in MUELLER'S *Archiv*, 1837, s. 320—327. Taf. XII., and *Recueil de Mémoires*, pp. 152—158.

B. Two oval clusters of numerous eyes (50 and more), transverse, situated in front of the antennæ at the sides of the head.

Sub-genus *Sphæropœus* BRANDT. Joints of antennæ six, the last large, truncated at the point.

Sp. *Sphæropœus insignis* BRANDT, *Zephronia ovalis* GRAY; a large species from Java, figured in this Manual.

Sub-genus *Sphærotherium* BRANDT. Joints of antennæ seven, the sixth oblong, the seventh the least.

Most of the species of this sub-division are from the Cape of Good Hope. The genera *Sphæropœus* and *Sphærotherium* are exotic, and seem to represent *Glomeris* in warm regions.

Family II. *Scolopendridæ*. (*Chilopoda* LATR.) Second pair of feet cheliform, terminated by a strong hook, which is perforate, covering the first pair of feet and the organs of manducation beneath, joined at the base, dilated, as if forming a second labium. Body depressed, covered above and below with horny scutes, the sides membraneous. Feet lateral, mostly a single pair in each segment, the last longest, extended backwards. Antennæ usually more slender towards the extremity, with numerous joints (14—40 and more). Organs of copulation situated at the posterior extremity of the body.

These animals live on animal food, insects, &c. Their nippers (feet of the second pair) contain the excretory duct of a poison-gland, which secretes a fluid deadly to small animals, as DE GEER[1] and LATREILLE[2] observed in flies; the bite of the large native species may cause great pain in man and violent inflammation and swelling[3].

Comp. on the family G. NEWPORT, *Monograph of the Class* Myriapoda, *Order* Chilopoda. *Transact. Linn. Soc.* XIX. p. 265.

A. Tarsi long, slender, multiarticulate. Antennæ setaceous, as long as the body.

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[1] *Insect.* VII. p. 557, on the bite of *Lithobius forficatus*.

[2] *Hist des Crust. et des Ins.* VII. p. 88, on the bite of *Scutigera araneoïdes*.

[3] LEEUWENHOECK first observed and figured the perforated nipper, *Vervolg. der Brieven* &c. pp. 138—140, fig. 10 (59th letter), and *Sevende Vervolg. der Brieven*, pp. 184—186 (124th letter).

*Scutigera* LAM. *Cermatia* ILLIG. Feet elongate, especially the last. Body behind the head covered with scutes above, the fourth longer than the rest. Eyes two, compound.

Sp. *Scutigera araneoïdes* auctor. (*Scolopendra coleoptrata* L.?) DUMÉR. *Cons. gén.* Pl. 58, fig. 6; GUÉRIN *Iconogr., Insect.* Pl. I. fig. 7: this animal has 15 pairs of long feet, which readily fall off as in gnats and harvest-spiders (*Phalangia*); it is found in France and other parts of Europe. LÉON DUFOUR has communicated some anatomical details regarding it in *Ann. des Sc. nat.* II. 1824, pp. 92—98. The compound eyes of *Scutigera* may be looked on as a special anomaly in this order; the cornea presents hexangular façettes, as already figured by SAVIGNY, *Descr. de l'Egypte, Myriapodes*, Pl. I.[1]

There are still some other species in the warm regions of the old and new world, but they appear to me to be not sufficiently determined. The figure of PALLAS (*Julus araneoïdes* in his *Spicilegia Zool.* IX. Tab. IV. fig. 16), ordinarily considered as synonymous with *Scutigera araneoïdes*, is certainly a different species. The figure of PANZER, *Deutschl. Insect.* Heft 50, No. 12, under the name of *Scolopendra coleoptrata*, however it be still referred to by later writers, has no relation to *Scutigera*, but appears to represent *Lithobius forficatus*.

B. Tarsi short, uniarticulate. Antennæ shorter than the body.

*Lithobius* LEACH. Superior scutes imbricate, unequal. Fifteen pairs of feet behind the cheliform feet. Antennæ with numerous joints, in adults above 40. Two groups of eyes in the external margin of the head behind the antennæ, the hindmost eye larger than the rest.

Sp. *Lithobius forficatus, Scolopendra forficata* L., GUÉRIN *Icon., Ins.* Pl. I., fig. 6; PANZER *Deutschl. Ins.* Heft 50, No. 13, Heft 190, No. 20; common in dunghills, under flower-pots, &c.; 10 lines long, 1½ lines broad. See on its anatomy TREVIRANUS, *Verm. Schrift.* II. 1817, s. 18—33. Taf. IV—VII., LÉON DUFOUR, *Ann. des Sc. nat.* II. pp. 81—91. It has seven pairs of *stigmata*. Here also in young animals the number of rings of the body and of the feet is smaller; the augmentation, as the animal grows, appears to occur in a manner different from that in *Julus*, so that new segments and new feet appear not behind, but between those already formed; and thus it is explained that the smaller dorsal shields are between the larger. GERVAIS, *Ann. des Sc. nat.*, sec. Série, Tom. VII. *Zool.* pp. 57, 58.

Sub-genus *Henicops* NEWP.

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[1] In a species still unnamed from Japan in the Leyden Museum, two Paris inches in length, (the European species attains a length of only 8 or 10 lines), I found these façettes $\frac{1}{16}$ millim. in diameter.

*Scolopendra* L. (exclusive of several species). Superior scutes plane, in some subequal, the posterior gradually larger in others unequal, with larger and smaller almost alternate. More than 15 pairs of feet (almost always 21), behind the cheliform feet. Antennæ with 17—20 joints. Eyes four on both sides, at the margin of the head behind the base of the antennæ.

To this genus belong the largest species of this division. In these *Myriapoda* there are 9 pairs of air-slits present, in the membraneous part between the dorsal and ventral scutes (in the 3, 5, 8, 10, 12, 14, 16, 18, and 20 ring), above and behind the insertion of the feet, (see my observations in the *Tidschr. voor nat. Gesch. en Physiol.* v. bl. 332—337. Pl. VI.) Comp. for the Anatomy GAEDE in WIEDEMANN'S *Zool. Magazin*, I. 1817. s. 105—109 with fig., and KUTORGA, *Scolopendræ morsitantis anatome*. Petropoli, 1834, 4to. The species investigated by this writer is *Scolopendra cingularis* LATR., which occurs in the south of Europe, in the Crimea and in Egypt. In north and central Europe no species of this genus occur. Formerly many species from different regions were confounded under the name of *Scol. morsitans* L.; the species figured by KOLLAR under this name (*Brasilien's lästige Insecten, Reise im innern v. Brasilien von* DR POHL, Wien, 1832, 4to, fig. 4) ought apparently to be referred to *Scolopendra subspinipes* GERV.

*Cryptops* LEACH. Twenty-one pairs of feet behind the cheliform feet. Eyes none. Antennæ with 17 moniliform joints.

Sp. *Cryptops Savignii* LEACH, *Scol. germanica* PANZER u. HERRICH SCHÆFFER, *Deutschl. Ins.* Heft 142, No. 2, &c. The species of this genus are distinguished, besides the absence of eyes, also by their much smaller size from those of the former[1].

*Geophilus* LEACH. Pairs of feet numerous, 40 and more. Body linear. Eyes none, antennæ with 14 joints.

Add sub-genera *Mecistocephalus, Necrophlœophagus, Gonibregmatus* NEWPORT, and some others formed by KOCH, *Syst. der Myriapod.* pp. 176—189.

Comp. on this genus also, GERVAIS, GUÉRIN *Magas. de Zoologie* 1835 (with a figure of a large species from France, *Geophilus Walkenærii*), and NEWPORT, *Proceedings of the Zool. Soc.* 1842, pp. 178—181. Sp. *Scolopendra flava* DE GEER, *Ins.* VII. Pl. 35, figs. 17—20, *Geophil. longicornis* LEACH, PANZER u. HERRICH SCHÆFFER, *Deutschl. Ins.* Heft 142, No. 5. Of this species TREVIRANUS has given an anatomy, *Verm. Schr.* II. s. 33—38.

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[1] Here also belongs the genus *Scolopendropsis* BRANDT, that appears to differ from *Cryptops* only by having two segments more.

The phosphoric light which some species diffuse (*Scol. electrica phosphorea*) is to be ascribed to a fluid that passes upon the skin from openings similar to those in the *Julidæ* (*Waga*). Numerous observations are recorded that myriapods of this division, after having caused lingering head-ache, have been sneezed forth by men from the nose (F. TIEDEMANN, *Von lebenden Würmern u. Insekten in den Geruchsorganen des Menschen*, Mannheim, 1844, 8vo, s. 11—17, to which examples many others may be added). To reject the observations, is certainly more easy than to explain the continued life of these insects in such an unusual situation.

*Scolopendrella* GERV. Antennæ with twenty joints, moniliform. Ocelli two. Segments of the body sixteen. Mouth not chelate, suctorial. Habit of *Geophylus*.

Comp. *Ann. des Sc. nat.* troisième Sér. *Zool.* Tom. II. p. 79, 8vo, Pl. 5, figs. 15, 16. Is this its place? Are the sucking *Scolopendræ* to be compared with the *Siphonizantia chilognatha* BRANDT?

## SECTION II. *Hexapoda.*

Feet six. Thorax separate from the abdomen.

### ORDER II. *Thysanura.*

Hexapod, apterous, not undergoing metamorphosis, not parasitic. (Mouth with mandibles and maxillæ. Two groups of simple eyes. Setæ or a bifid tail in most at the end of the body).

Θυσάνουροι from θύσανος, *a fringe, a tuft*, and οὐρά, thus named from some species which have jointed threads at the posterior extremity; in others there is a forked tail which in a state of rest is bent forwards beneath the body, and on extension gives a blow to the ground, which causes the body to spring upwards: hence they may be named *spring-tails*. In some however the posterior part of the body has only two small conical hairs (*Podura fimetaria* L.) or no appendage at all. The body is generally elongate. Some are very small, and even the largest species are scarcely half an inch long. They love moisture, and live on the ground, under stones, in mould or old fallen leaves, under the bark of trees, in dark corners of houses, &c. They undergo no metamorphosis, but change their skin often.

The intestinal canal is straight, the stomach wide. In *Lepisma* there are two, in *Smynthurus*, according to *Nicolet*, three vessels for secreting urine. The external sexual organs are placed at the posterior extremity of the abdomen. In the female of *Lepisma* a split tube or borer is found which serves for depositing the eggs.

The nervous system in *Smynthurus* presents only four ganglia, of which the first and second lie very close together, the first above, the second below the œsophagus (NICOLET); in *Lepisma saccharina*, on the other hand, TREVIRANUS found twelve ganglia. The two eyes, which in most species are small, consist of a group of eight, sometimes six or seven, in *Podura fimetaria* of fourteen simple eyes (NICOLET); in *Lepisma saccharina* twelve simple eyes are counted on each side.

These Insects, however nearly allied to the myriapods, approach still more nearly to the *Orthoptera*, and especially to the genus of the earwigs (*Forficulæ*); see this *Manual*, first edition, I. 1828. pp. 204, 205. But if, on account of this affinity, any one would place *Lepisma*, or even the whole order of *Thysanura*, amongst the *Orthoptera*, I think he would go too far. Time, the touchstone of all things, would reject the union. If LATREILLE had united the *Thysanura* with the *Orthoptera* in one order, zoologists of the present day would for certain have perceived long ago that these Insects were not in their place.

Comp. on this order: TREVIRANUS *Verm. Schr.* II. s. 11—17. Tab. II. III. and IV. figs. 1—5 (on the anatomy of the genus *Lepisma*); BURMEISTER in OKEN'S *Isis*, 1834, s. 137, 138 (on the respiratory organs and the *stigmata* of *Lepisma*, whose presence TREVIRANUS had erroneously denied); LATREILLE, *De l'Organisation extérieure et comparée des Insectes de l'ordre des Thysanoures, Nouv. Ann. du Mus.* I. 1832, pp. 161—187; R. TEMPLETON, *Thysanura Hiberniæ, or Descriptions of such species of spring-tailed Insects*, Podura and Lepisma, *as have been observed in Ireland, Transact. of the Entomol. Soc. London*, 1836, I. pp. 89—98, Pl. XI. XII.); H. NICOLET *Recherches pour servir à l'Hist. des Podurelles*, 88 pages et 9 planches (*Neue Denkschr. der allg. Schweizerische Gesellschaft für die gesammt. Naturwissensch.* Bd. VI. Neuchatel, 1841, 4to); BURMEISTER, *Handb. der Entomologie*, II. 2, 1838, s. 443—458; GERVAIS in WALKENAER, *Hist. des Ins. aptères* (Suites à BUFFON chez ROBET), III. 1824, pp. 377—456, &c.

Family III. *Lepismenæ*. Body elongate, mostly covered with minute scales. Antennæ setaceous, with joints numerous, very short. Palps four, elongate. Abdomen of nine or ten distinct segments, besides other appendages supplied with three (or more rarely with two) long setæ, articulated towards the extremity.

*Machilis* LATR. Antennæ inserted under large, contiguous (compound?) eyes. Maxillary palps, exsert, filiform, long. Body arcuate, with convex back, saltatory. Three setæ at the extremity of the abdomen, the middlemost larger than the lateral.

Sub-genera *Petrobius*, *Machilis* LEACH.

Sp. *Machilis maritima* LATR., *M. polypoda* DUMÉR. (not LATR.), *Cons. gén.* Pl. 54, fig. 2, &c. Besides the jointed threads (two on most of the segments of the abdomen), GUÉRIN has observed in *Machilis* vesicles also on the same segments, which he compares to gills; *Ann. des Sc. nat.* sec. Série, *Zool.* v. pp. 374, 375, *Iconogr.*, *Ins.* Pl. II. fig. 1 f. These animals remind us of larvæ of *Ephemera*.

*Lepisma* L. (in part). Antennæ inserted amongst eyes, small, remote. Palps moderate. Body depressed, squamose, not saltatory, terminated by three subequal setæ.

Sp. *Lepisma saccharina* L., GUÉRIN *Iconogr.*, *Ins.* Pl. 2, fig. 2; GEOFFROY *Ins. Par.* II. Pl. XX. fig. 3; HOOKE *Micrographia* 1667, Tab. 33, f. 3, pp. 208—210. It is said that this insect was imported into Europe from America, where it lives in sugar: in Sweden it is rare, according to DE GEER; it is not spotted, covered with silvery scales, which under the microscope are finely ribbed longitudinally, and differ much in size and form. This insect runs very rapidly, and with us is usually found in clothes-chests, between damp books, &c.

Sub-genus *Lepismina* GERV. is distinguished by the body plane, the thorax very broad.

Sp. *Lepisma aurea* LÉON DUFOUR, *Ann. des Sc. nat.* Tom. XXII. p. 419. Tab. XIII. fig. 1.

*Note.*—Genus *Nicoletia* GERVAIS is distinguished by defect of eyes, and body not scaly; *Campodea* WESTWOOD, *Ann. of Nat. Hist.* Tom. X. 1842, p. 71, by the same characters and by the tail composed of two setæ only. Is it *Podura ambulans* L.?

Family IV. *Podurellæ*. Body in some elongate, in others globose, broad, covered usually with hairs, sometimes with scales also. Antennæ with few joints, or with four longer joints at the base, at the apex only with short numerous joints. Palps inconspicuous. Abdomen composed of only six or fewer segments, mostly terminated by a forked tail, during rest bent forward beneath the abdomen, serving for springing.

*Podura* L.

*Spring-tail* (properly *foot-tail*, since the tail is used like feet for motion). They are small insects, which live on trees, under bark, under stones, on moist earth, &c. Some are met with on the surface of water. Since the tail, according to WAGA, is at first wanting in young animals (*Ann. de la Soc. Entom. de France*, XI. quoted by

ERICHSON, *Jahresbericht, Arch. f. Naturgesch.* 1843, 8. 270), it is possible that sometimes young specimens of *Podura* may be placed under the genus *Lipura* (*Anurophorus* NICOLET); but this entire genus is not on that account to be rejected, for it is very usual that a young form in a natural family should be represented by a permanent generic form. The most remarkable deviation in this family is that of the genus *Anura* GERVAIS (*Achorutes* NICOLET), where in place of jaws there is a suctorial mouth; see NICOLET op. cit. p. 33, Pl. IV. fig. 5.

*Sminthurus* LATR. Thorax and abdomen conjoined into a globose body. Antennæ geniculate; terminal portion of antenna setaceous, multi-articulate.

GUÉRIN, *Iconogr. Ins.* Pl. 2, fig. 4. (Add sub-gen. *Dicyrtoma* BOURLET).

*Podura* LATR. Thorax separate from abdomen; body elongate, with abdomen narrow, oblong.

A. Mandibles and maxillæ none. Suctorial tube conical.

*Anura* GERV. (*Achorutes* NICOLET not TEMPL.) No forked tail. Abdomen rotundate behind.

B. Mandibles and maxillæ.

*a*) Antennæ short, with four or five joints.

*Lipura* BURM. (*Anurophorus* NICOLET). Body not scaly. Abdomen, instead of a forked tail, terminated by two very small conical diverging tubercles.

Sp. *Podura fimetaria* L., *Lipura ambulans* GERV. (*nat. Pod. ambulans* L.), DE GEER, VII. p. 33. Pl. 3, figs. 5, 6. NICOLET op. cit. Pl. 5, fig. 2, common in garden-mould and in flower-beds, ivory-white, 1 line long.

*Achorutes* TEMPLETON, *Hypogastrurus* BOURLET, *Podura* NICOLET. Body not squamose. Tail forked, short.

Sp. *Podura aquatica* L., DE GEER, *Ins.* VII. Pl. II. figs. 11—13, NICOLET op. cit. Pl. 5, fig. 4; one line long, very common with us, forms large black spots on the water, near which other white spots are floating, formed by the cast skins.

*b*) Antennæ longer than head.

Genera *Isotoma* BOURLET (*Degeeria* NICOLET, *Desoria* NIC.), *Heterotoma* BOURLET, *Orchesella* TEMPLETON, *Lepidocyrtus* BOURLET

(*Cyphodeirus* NICOLET), *Tomocerus* NICOLET (*Macrotoma* BOURLET.)

Sp. *Desoria glacialis* NICOLET, l. l. Pl. 5, fig. 10; first found in 1849 on *Monte Rosa*, afterwards on the *Unter-Aar glacier*; see AGASSIZ *Geologische Alpenreisen* von DÉSOR, *Deutsch* von C. Vogt, Frankf. a. Main, 1844. 8vo, s. 181, 182.

## ORDER III. *Parasitica.*

Hexapod, apterous, not undergoing metamorphosis, parasitic. Two simple eyes, sometimes none.

These animals, also named *Epizoa* (as opposed to Entozoa, our fifth class, see above), cannot well be otherwise defined than by the short account that we have given of them. The absence of a forked tail or of setæ on the abdomen[1], distinguishes them indeed from most but not from all Insects of the former order. The flea and some wingless species of the order *Diptera* are distinguished from these *parasites* by their undergoing complete metamorphosis.

Comp. on this division C. L. NITZSCH, *Die Familien und Gattungen der Thierinsecten* (insecta epizoica), in GERMAR u. ZINCKEN, *Magazin der Entomologie*, III. Halle 1818, s. 261—316. Here however the parasitic *Diptera* (*Hippobosca, Nycteribia* &c.) are included in the same division. NITZSCH arranged the rest according to their oral organs, those in which they are suctorial, amongst the *Hemiptera*, those in which they are manducatory, amongst the *Orthoptera*; two orders in which the inclination to abortion of the wings is evident, and which undergo an incomplete metamorphosis, which therefore in the wingless genera can shew itself as change of skin alone.

See also GURLT *Ueber die auf den Haus-Saügethieren und Hausvögeln lebenden Schmarotzer-Insecten und Arachniden, Magazin für die gesamte Thierheilkunde*, VIII. 1842. s. 411—433. Tab. IV. and IX. 1843. s. 1—24. Tab. I. Some figures are also found in LYONET, *Recherches sur differentes espèces d'Insectes, ouvrage posthume*, Paris 1832, 4to; DENNY, *Monographia Anoplurorum Britanniæ*, or *An Essay on the British Species of Parasites*, London, 1842; a work of detail which I received too late to make use of.

Family V. *Hæmatopina* s. *Pediculina.* Mouth anterior, composed of a rostellum, retractile, vaginate at the base. Tarsi uniarticulate, with single arcuate claw[2].

*Pediculus* L. (exclusive of several species). Antennæ filiform, quinquearticulate. Vagina of the rostrum aculeate at the point.

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1 Hence the name *Anoplura* LEACH. See his work *On the Families, Stirpes and Genera of the Order Anoplura, Zoological Miscellany*, III. 1817, pp. 64—67.

2 By some writers this hook is considered as the second joint of the tarsus.

The species of this genus occur only in man and some mammals, whose blood they suck. Their motion is sluggish.

The louse of the human head has been investigated anatomically by our SWAMMERDAM. The intestinal canal is straight, with a large stomach; there are four vessels secreting urine. Each ovary consists of five tubes. The nervous system consists, besides the cerebral ganglion, of three large ganglia in the thorax, so closely placed behind each other as to touch; from these ganglia the nerves of the feet arise, and from the last ganglion arise in addition six nerves which are distributed through the cavity of the abdomen.

See SWAMMERDAM *Bijbel der natuur.* bl. 63—86. Tab. I. II.[1]

Sub-genera *Phthirus, Hæmatopinus, Pediculus* LEACH.

Sp. *Pediculus humanus capitis, Pediculus cervicalis* LEACH, DE GEER *Ins.* VII. Tab. 1. fig. 6, DUMÉRIL *Consid. gén. s. l. Ins.* Pl. 53, figs. 1, 2, GUÉRIN *Icon. Ins.* Pl. 2, fig. 5. (Comp. also SWAMMERDAM, and a gigantic figure twenty inches long by HOOKE *Micrograph.* Tab. 35). The larger species, considered by LINNÆUS as a variety, which lives upon the body and amongst the garments, differs by the less deep incisures in the side of the abdomen at each ring, by a thorax broader behind, and, as GUÉRIN has remarked, by longer antennæ. *Pediculus humanus corporis* DE GEER, *Ins.* l. l. fig. 5, (*Pediculus humanus* LEACH, *Pediculus vestimenti* BURM.) As a third parasitic species of man may be added *Pediculis pubis* L., *Phthirus inguinalis* LEACH, REDI *Exper. circa generationem Insectorum*, Amstelodani, 1688, 12mo, Tab. 12, fig. superior, GUÉRIN op. cit. fig. 17.

Family VI. *Mallophaga.* Mouth supplied with mandibles and maxillæ. Tarsi biarticulate, with a single claw or with two.

On Mammalia, and especially on Birds, different parasitic Insects are found, which were placed by LINNÆUS in the genus *Pediculus*, but which differ from it by the presence of jaws on the under surface of the head. DE GEER, who discovered this character, justly held it to be so important and essential, that he placed these animals in a distinct genus, to which he gave the name of *Ricinus*

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[1] LEEUWENHOECK investigated the male louse (which is rarer and was unknown to SWAMMERDAM, op. cit. bl. 83); he found two *testes* on each side of the body. This and other remarkable peculiarities in *Pediculus hum. corporis* are found in LEEUWENHOECK, *sesde Vervolg. der Brieven.* Delft, 1697, 98ste Missive, pp. 187—217. See also *Vierde Vervolg. der Brieven* 1694, 77ste Missive, pp. 587—591, where the head is described and figured. The horny sheath of the *penis* L. described as a sting at the posterior part of the body.

(*Mém. pour servir à l'Hist. d'Ins.* VII. p. 69). J. F. HERMANN changed this name, which had already been given to a genus of plants, to *Nirmus*[1]; NITZSCH, who adopted this name for a subgenus alone, named these animals *Mallophagæ*, from μαλλός, *fleece*, since they live on hair, on scales of the epidermis and feathers, and not on blood. In birds there are no lice of the former family known,—all the bird-lice belong to the *Mallophagæ*. In some are found small, moveable, oblong organs in front of the antennæ, like a second pair of imperfect antennæ, which NITZSCH names *trabeculæ*. The eyes are often difficult to distinguish: in some they are entirely wanting.

A. Antennæ filiform. Maxillary palps none, labial very short, biarticulate.

*Philopterus* NITZSCH. Antennæ quinquearticulate. Claws of tarsi two.

Sp. *Philopterus baculus* NITZSCH, REDI op. cit. Tab. II. *figura superior*, LYONET, op. cit. p. 41, pl. 5, fig. 10, GURLT *Magaz. f. d. ges. Thierheilk.* VIII. Tab. IV. fig. 9, on Pigeons. All the species of this genus live upon birds. Here belong the sub-genera *Goniodes*, *Lipeurus*, *Nirmus* and *Docophorus* of NITZSCH, together with *Goniocotes* BURM. and *Ornithobius* DENNY[2].

*Trichodectes* NITZSCH. Antennæ triarticulate. Tarsi with a single claw.

The species of this genus live only on Mammalia. Sp. *Trichod. latus* NITZSCH, *Ricinus canis* DE GEER, *Ins.* VII. Tab. IV. fig. 16, GURLT op. cit. IX. Taf. I. fig. 1.

B. Antennæ clavate (four joints). Maxillary palps conspicuous.

*Liotheum* NITZSCH. Tarsi biunguiculate. Labial palps biarticulate, short.

The species of this genus keep to birds, often of the same species on which *Philopteri* also live[2]. Here belong the sub-genera *Colpocephalum*, *Menopon* (*Menopon* and *Nitzschia* DENNY), *Trinotum*, *Eureum*, *Læmobothrium*, *Physostomum* of NITZSCH. These insects move more quickly and creep more nimbly beneath the feathers than the *Philopteri*. Sp. *Liotheum subæquale* NITZSCH, LYONNET l. l. Pl. 4, fig. 5, on crows, &c.

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[1] *Mémoire Aptérologique*, 1804, p. 12.

[2] Five different species of *Mallophaga* occur on fowls. Such names, therefore, as *Pediculus gallinæ* may readily introduce confusion.

*Gyropus* NITZSCH. Tarsi uniunguiculate. Labial palps none.

Of this genus only few species are known, which live on the *Cavia* and the Sloth (*Bradypus tridactylus*) *i. e.* on American species of Mammalia."

## ORDER IV. *Suctoria s. Siphonaptera.*

Apterous, hexapod, undergoing perfect metamorphosis. Mouth suctorial; rostellum formed of two serrated laminæ and a single more slender seta, included in a bivalve articulate sheath.

Family VII. *Pulicidæ* (characters of the order are those of the single family).

*Pulex* L. [Characters of the order.] Body compressed. Antennæ short, with three or four joints, the last large, flat, serrated, received in a small cavity and covered with a scale. Maxillary palps with four joints, porrect. Posterior feet saltatory. Tarsi with five joints.

The order of *sucking Insects*, which contains the genus Flea, agrees in the complete metamorphosis with the *Diptera*; but the oral parts have little resemblance. The flea is perfectly distinguished from the hemipterous sucking Insects not only by the perfect metamorphosis, but also by the oral parts, by the presence of palps for instance. DUGÈS first drew attention to four small round plates, which are situated on the last two segments of the thorax, and of which the posterior pair is the largest. These plates, which in colour and substance do not differ from the rest of the horny covering of the body, may be looked on as rudiments of wings. The resemblance with the metamorphosis of the *Hymenoptera*, especially in the pupa, together with the presence of these four rudimentary wings, may serve to explain in some degree why an inclination has prevailed to regard the *suctoria* as abortive hymenopterous Insects.

There are two simple eyes, which in *Pulex vespertilionis* DUGÈS are wanting. The sucker is inclosed by the flat *labial palps* consisting of (three?) joints, and is composed of two flat setæ serrately toothed on the edge and ribbed longitudinally in the middle (*scalpella* KIRBY and SPENCE, *mandibles*), and a thin smooth thread of the same length (*ligula* SAV.) There is no upper lip present, unless it be

represented by this *ligula*[1]. The *maxillæ* are two small plates at whose base are attached the feelers stretching forwards, and which were formerly regarded as antennæ; they have four oblong joints, of which the second and the fourth are the longest.

The intestinal canal of the Flea is short and straight; its stomach is cylindrical, the small intestine as long as the stomach, and rectum short. There are four short and wide urinary tubes, which are implanted at the inferior orifice of the stomach. At both sides are two salivary vessels in form of round vesicles, whose efferent ducts coalesce to form a canal on each side of the œsophagus, which mounts tortuously to the mouth.

See Ramdohr, *Abhandlung üb. d. Verdauungswerkzeuge der Insecten*, s. 202. Tab. XXIII. fig. 2.

Comp. on this family A. Dugès, *Recherches sur les Caractères zoologiques du genre* Pulex, *et sur la multiplicité des espèces qu'il renferme. Ann. des Sc. nat.* XXVII. 1832, pp. 165—175, Pl. IV., and P. F. Bouché, *Bemerkungen über die Gattung* Pulex, *Nov. Act. Acad. Cæs. Leop. Car.* Tom. XVII. 1835, p. 501—508 (this writer considers the parts indicated above as *mandibles* to be *laciniæ* of the under-lip, and gives the maxillary palps five joints).

Sp. *Pulex irritans* L. (in part), Hooke *Micrographia* Tab. 34 (a large figure of full 15 Rhenish inches, or 4 decimeters in length), Dugès l. l. fig. 1 (both figures represent the female). Ordinarily this species is confounded with others which occur on the dog and domestic cat, *Pulex canis* Dugès, *Pulex canis* and *Pulex felis* Bouché. To the last-named refer the figures of Roesel, *Ins.* II. *Muscar. atque Culicum*, Tab. II—IV. (Tab. III. fig. 10, representing a male, refers according to Bouché to *Pulex irritans*). Moreover these species can bear leaving their natural habitat for a time, and thus *Pulex irritans* may pass on to dogs, *Pulex canis* on to man. A particular species also occurs on fowls, *Pul. gallinæ*, Schrank, Bouché. All the species of this genus are small insects; the largest hitherto known, *Pulex gigas*, has only a length of two lines, *Fauna Bor. Americana* of J. Richardson, Vol. IV. 1837. The hip (*coxa*) of the feet is as large as the thigh (*femur*) and very thick; the fore-feet are placed far forwards, almost under the head. The abdomen is large, on the upper surface in the male, concave; in copulation the female is placed on the back of the little male. The eggs are white, oblong, sticky. In the summer season the larvæ come forth after a lapse of six days, having no feet, and resembling small, white worms. Leeuwenhoeck brought them up on dead flies, Roesel on dead gnats and dried pigeon's blood. Blood that has followed

[1] Dugès, *Ann. des Sc. nat.* sec. Série. Tom. VI. 1836. *Zool.* p. 130.

the prick of fleas and has dried into black globules, is often found dispersed by the flea near the eggs that are laid in the chinks of wooden floors, in furniture, &c., and these globules form, according to the observations of De France (*Ann. des Sc. nat.* I. 1824, pp. 440—443) the favourite food of the larvæ. These larvæ within eleven days are full grown, then spin themselves up and change into pupæ, from which after ten or eleven days the perfect insects appear; in this way a new generation arises after the lapse of only four weeks. Comp. Leeuwenhoeck, *Vierde Vervolg. van Brieven* 1694. bl. 537—572, 76ste *Missive*, and Roesel, *Insecten-Belustigung*, IV. *Mucken und Schnacken*, s. 9—24.

In America, particularly in the Brazils, there is a small species of flea, whose proboscis is longer; the fore-feet are not so far forward, and whilst the labial palps are wanting, the three threads of the sucker are not surrounded by a bivalved sheath. Consequently it has been proposed to make a distinct genus of this species (*Sarcopsylla* Westwood, *Dermatophilus* Guérin). This species, which lives in the open air, and is often in great numbers in sandy places, is *Pulex penetrans* L., Duméril, *Cons. gen. s. les Insects.* Pl. 53, figs. 4, 5; Guérin, *Iconogr., Insect.* Pl. 2, fig. 9; Kollar, *Brasilien's vorzüglich lästige Insecten*, fig. 5, s. 8, 9. The Portuguese call the animal *Bicho*, the Brazilians *Tunga*; it bears also the name of *Pique, Nigua*[1], &c. and of *Chigoe* amongst the English residents. This insect penetrates beneath the skin of the feet, sometimes also of the hands of man, and of the feet of dogs and other mammals; the female, after she has penetrated beneath the skin, expands astonishingly, whence malignant ulcers arise, which sometimes occasion death. They infest principally newly-arrived Europeans: see V. Humboldt's *Reise in die Æquinoctial-Gegenden des neuen Continents*, IV. 1823, s. 90, J. J. Von Tschudi (who once had six tumours thus caused on his right foot) *Peru, Reiseskizzen*, I. 1846, s. 310, 311. A capuchin monk attempted to transplant a family of these insects from St Domingo to Europe, but his zeal remained unrewarded, for his foot in which he had harboured the colony, was obliged to be amputated on the voyage (Kirby and Spence, *Introd. to Entomol.* I. p. 102). Comp. on this little animal also Dugès, who especially has illustrated the parts about the mouth, *Ann. des Sc. nat.* sec. Série, Tom. VI. 1836. *Zoologie*, pp. 129—134. Pl. 7 B. A forked caudiform appendage, already figured by Catesby, and compared by Linnæus with the tail of *Podura*, is probably a male organ of copulation (Guérin, *Iconogr.*); at least it does not occur in all individuals.

## Order V. *Strepsiptera s. Rhipiptera.*

Hexapodal Insects; (male) with four wings; anterior wings two small moveable bodies, inserted into the sides of the thorax; posterior wings large, membranous, resembling a quadrant of a circle, folded longitudinally like a fan. (Females apterous, apodous).

[1] *Nigua* is the name also given to a species of *Acarus* (*Ixodes americanus*), which also penetrates beneath the skin, and must not be confounded with this flea.

Metamorphosis complete. Mandibles two, forficate, narrow, subarcuate. Palps two biarticulate, very distant, inserted under the head. (Larvæ and Pupæ living parasitically in different *Hymenoptera*.)

This order, first distinguished by KIRBY, cannot well be united with one of the others, and least of all with that of the Hemipterous Insects, as some would desire. The natural affinity is difficult to determine; perhaps this order stands between the *Orthoptera*, *Neuroptera*, and *Hymenoptera*. In this uncertainty respecting the true place, we think we have some grounds for our choice, to place it after the flea, in the perfect metamorphosis as well as in the presence of four rudiments of wings in the genus *Pulex*. However small, moreover, the number of insects of this order may be, that can afford no sufficient reason either in an artificial or in a natural system for rejecting it.

The winged individuals, on which the characters of the order are founded, are, as BURMEISTER had sagaciously surmised, and the complete investigations of the excellent C. TH. VON SIEBOLD have demonstrated, all males. In these, two large compound eyes are present, which consist of few façettes, separated from each other by a raised margin. Simple eyes are wanting; the antennæ are composed of few joints, ordinarily split at the extremity into two parts, or as if branched with lappet-like appendages. In front of the wings are two small convoluted parts, named by KIRBY *Elytra*, but which do not cover the wings. It was formerly thought that they were attached to the first ring of the thorax, and in that case they could not in any sense be looked on as imperfect wings or *elytra*; but more accurate investigation has proved that they belong to the *metathorax*, and, therefore, may keep the name given to them by KIRBY. They recal the short *elytra* of some *Phasmatidæ*. The middle piece of the thorax is prolonged into a shield over the abdomen. The tarsi have mostly four joints, in other species three or two, and no claws at the extremity. The wings (hind wings) are large, thin, whitish, opaque, and have some nervures which radiate towards the circumference. The oral organs are somewhat differently described by SAVIGNY, whilst he regards as *maxillæ* the parts described by KIRBY as *palpi*[1]. The under lip has no *palpi*. (WESTWOOD considers the *palpi* as belonging to the under lip, and

[1] SAVIGNY'S communications to LEACH were published by the latter in his *Zoological Miscellany*, III. 1817, p. 135.

the *mandibles* as *maxillæ*. According to this view the mandibles would be wanting.) These insects undergo complete metamorphosis. At first the larva has six feet and two threads at the abdomen, (somewhat the form of *Lepisma*); afterwards these feet disappear, for the insect then lives in the abdomen of larvæ of *Hymenoptera*. In these *Hymenoptera*, also, the parasite is changed into a pupa, which in the perfect *Hymenoptera* projects between the rings of the abdomen. The wingless female remains in this situation, and is impregnated there. It is viviparous. The six-footed larvæ, which in the genus *Xenos* jump like *Podurellæ*, were described by KLUG and WESTWOOD, and previously also by VON SIEBOLD, as parasites.

Comp. on this order W. KIRBY, *Strepsiptera, a new order of Insects, Linnæan Transact.* Vol. XI. 1815. pp. 86—122, Tab. 8, 9; *Addendum*, pp. 233, 234; LEACH on the *Rhipiptera* of LATREILLE, *Zool. Misc.* III. pp. 133—136; W. B. PICKERING, *Observations on the Economy of the Strepsiptera, Transact. of the Entomol. Soc.* London, I. 1836, pp. 163—172, Pl. XVII; J. O. WESTWOOD, *Description of a new Strepsipterous Insect*, ibid. pp. 173, 174, Pl. XVII. fig. 15; C. TH. V. SIEBOLD, *Ueber Xenos Sphecidarum und dessen Schmarotzer, Beiträge zur Naturgeschichte der Wirbellosen Thiere*, 1839, s. 72—87, Tab. III. figs. 62—74; by the same *Ueber Strepsiptera*, in ERICHSON'S *Archiv f. Naturgesch.* IX. 1843, s. 137—162. Tab. VII.

Family VIII. *Strepsiptera s. Stylopidæ.* [Characters of the order.]

* Tarsi with four joints.

*Xenos*[1] ROSSI. Antennæ bipartite, single at the base, triarticulate, with first joint obconical, longer, with branches semi-round, acuminate, not articulate.

Sp. *Xenos Peckii*, KIRBY, *Linn. Trans.* Tab. 8, Tab. 9, fig. 1, KIRBY and SPENCE, *Introd. to Entom.* I. Pl. II. fig. 1; the larva infests *Polyste fucata* (nor. Amer.); &c. European species are *Xenos Rossii* and *Xenos Sphecidarum*. They are all small insects whose body is only about 1½ line long.

*Stylops* KIRBY. Antennæ bipartite with stem single, biarticulate, upper branch triarticulate, (Antennæ have six joints, the third

[1] ξένος or ξεῖνος, *a guest*; because harboured by other insects.

joint forming a produced, lanceolate branch, almost equal in length to the three last joints).

Sp. *Stylops melittæ*, &c. Icones: WESTWOOD, Introduct. Frontisp. Vol. I. fig. 6; *Stylops Spencii*, GUÉR. *Iconogr., Ins.* Pl. 92, fig. 1, *Styl. Dalii*, LEACH, *Zool. Misc.* III. Tab. 149, *Styl. Kirbii*.

** Tarsi with three or with two joints.

*Halictophagus* CURTIS. Tarsi with three joints. Antennæ with seven joints, supplied externally with lamellæ disposed pectinately.

*Elenchus* CURTIS. Tarsi with two joints. Antennæ bipartite, with stem simple, biarticulate, and upper branch biarticulate, elongate, slender.

Comp. CURTIS, *British Entomology* quoted by WESTWOOD, *Introduction* II. pp. 287, &c.

## ORDER VI. *Diptera.*

Hexapod Insects with two wings, and two poisers. Mouth suctorial, with labium not palpigerous produced into a proboscis, or a sheath, which receives and incloses in a groove above an haustellum formed of setæ, various in number. Two palps (maxillary) at the base of the proboscis. Metamorphosis complete.

*Two-winged. Diptera* L., *Antliata* FABR. The principal works on this order are the following:—

J. C. SCHELLENBERG, *Gattungen der Fliegen, in* 42 *Kupfertafeln entworfen.* Zurich, 1803. 8vo (with german and french text).

J. C. FABRICII, *Systema Antliatorum.* Brunsvigæ, 1805. 8vo.

J. W. MEIGEN, *Systematische Beschreibung der bekannten Europäischen zweiflugeligen Insekten. Mit Kupfertafeln.* VII. *Theile,* 8vo. Aachen und Hamm, 1818—1838.

C. R. W. WIEDEMANN, *Aussereuropäische zweiflügelige Insekten. Mit Steintafeln.* II. *Theile,* 8vo. Hamm, 1828, 1830.

*Histoire naturelle des Insectes Diptères* par MACQUART, *av. pl.* II. Tomes, 8vo. Paris, 1834, 1835. (The work of FALLEN, *Diptera Sueciæ*, Lund. 1814—1827, 2 vol., I have not been able to inspect.)

The general covering is, on the whole, very thin. The body consists, as in the other hexapod Insects, of three principal parts:

the head, the trunk, and the abdomen. On the head two compound eyes are usually seen, which are very large, especially in the male; in the most, simple eyes or eyespots are also present, usually three, sometimes only two in number. The antennæ are placed on the frons close to the eyes; ordinarily they are, in comparison with those of other orders, short. Some sub-divisions of the genus *Tipula* L., make an exception to this, and the genera *Macrocera* MEIG. and *Megistocera* WIEDEMANN are especially distinguished by their long antennæ. The sucker consists of two, four, or six sharp threads, which in the last case represent the upper lip (*labrum*), the tongue (*ligula*), the two upper and the two under jaws. At the under jaws (*maxillæ*) or, when these are wanting, at the base of the sucker, two feelers are attached, which sometimes consist of five, sometimes only of two joints, or of a single joint. The under lip forms an univalve sheath excavated above, in which the sharp threads or stings reside by means of which these insects wound; on this part there are no feelers. The first piece of the thorax is a small ring, forming a neck-ring, but the middle piece (*mesothorax*) is large, and forms nearly the whole of the thorax. To this division of the thorax the wings are attached. These are veined, usually transparent as glass, and colourless, occasionally spotted; they are without that little horny point at the anterior or external margin (*punctum callosum* s. *cubitale*) which is seen on the anterior wings of the *Hymenoptera*. Behind the wings there is mostly found a small special appendage, a membranous scale (*squama halterum*), which may be regarded as a part of the wing. To the *metathorax* the poisers (*halteres*) are attached, which consist of a thin pedicle and a button. These *halteres* are also found in species that have no wings. They are to be considered as rudiments of hind-wings[1]. The abdomen is often united to the trunk by a small part alone of the diameter of its base, and consists of from four to nine rings. In the female it generally runs to a point at the posterior extremity; if here fewer rings are found, it is because the last of them form an *ovipositor* or case consisting of rings that can be pushed in and out of each other, like a pocket telescope. The feet are in most long and slender, and terminate always with tarsi

[1] See above, p. 252; comp. also WESTWOOD, *Introd. to modern Classific.* II. p. 500. LATREILLE regarded these parts not as rudimentary hind-wings, for he thought they were attached to the abdomen.

consisting of five joints. The last joint has two claws and two or three plane elevations or cushions (see above, p. 252).

The digestive organs of *Diptera* consist of a wide bent stomach of moderate length, a small intestine, and an oval oblong large intestine. The salivary vessels vary in the different genera of this order. The œsophagus has a dilatation (*ingluvies, crop*, see above, p. 254); it is a bladder of various form, either simple, or prolonged into two or more divisions, and communicating with the œsophagus by a long narrow tube (often with its lowest part close above the stomach). In larvæ the tube is shorter and inserted into the œsophagus higher up. In by far the greater number of *Diptera* this bladder is present[1], in the family of the *Pupiparæ* it is wanting (comp. RAMDOHR, *Abhandlung. üb. die Verdauungswerkzeuge d. Ins.* Tab. XIX.—XXI, and pp. 170—185). TREVIRANUS named this organ, which is also found in the *Hymenoptera* and *Lepidoptera*, sucking-bladder; he attributed to it a power of expanding, in consequence of which the air in the œsophagus is rarified, whilst, to fill this partial vacuum, the fluid in which the extremity of the sucker is planted ascends as if pumped up, (*Verm. Schr.* II. s. 110). The *Hemiptera* and the *Pulicidæ* do not possess this bag; on the other hand, such a crop is present in the *Orthoptera*, which do not suck, and according to LÉON DUFOUR in *Œdemera* amongst the *Coleoptera* (*Ann. des Sc. nat.* III. 1824, p. 484, Pl. 30, fig. 7). The name of *food-bag*, which was given by RAMDOHR to this part in *Diptera*, is therefore more appropriate than that of sucking-bladder. When flies that have long fasted suck their full of milk, according to the investigations of HUNTER, milk penetrates into this bladder. By pressure of the abdomen, and apparently also by contraction of the muscular walls of the bladder itself, the food is afterwards brought back from this *diverticulum* or reservoir of nutriment to the sto-

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[1] According to the anatomical investigations of SCHRŒDER VAN DER KOLK it seems to be wanting in the larva of *Œstrus;* but at the same point where ordinarily the tube from the food-bag [the name given by RAMDOHR to the sac] is inserted into the œsophagus, two tortuous canals are seen, which divide at their other extremity into two branches, which are distributed to the adipose body. *Mémoire sur l'Anatomie et la Physiologis du Gastrus equi.* Amsterdam, 1845, pp. 29, 30. Pl. III. fig. 1, b, s, s. RAMDOHR has figured four such appendages above and near the stomach in the larva of *Musca vomitoria*, which would seem at their other extremity to be implanted into the salivary vessels, and in the perfect insect to disappear. Tab. XIX. fig. 1. M, M, M, M. Do these vessels form, perhaps, a second apparatus for secreting saliva?

mach; (see *Catalogue of the Physiol. Series of Comp. Anat. contained in the Museum of the Roy. Coll. of Surgeons*, I. 1833, pp. 189, 190).

The *Diptera* live long in the larva-state, but ordinarily very briefly as perfect insects (flies however live long in this last state). Their larvæ have no feet, but some of them have appendages which resemble them, or small hooks, which serve for motion or holding fast, as for instance, the larva of *Œstrus*. All these Insects undergo complete metamorphosis. Some larvæ cast their skin before changing into pupæ, and some in addition spin themselves up. Others, on the contrary, do not cast their skin, but this shrinks, hardens, and forms for the pupa, that resembles an egg, a kind of shell or case (*pupa coarctata*, see above, p. 273). The internal parts separate themselves from this shell, and the change into pupa occurs within this integument, which at last is deserted by the perfect insect when it breaks off the uppermost part in the form of a lid.

Many of these animals are injurious to us by their puncture; others suck the blood of our domestic animals; some spoil our food by depositing their eggs on it, especially on flesh and cheese, where the larvæ (maggots) are developed. There is, on the other hand, no single species of this order from which we immediately derive advantage. Yet so much the greater is the utility they afford us indirectly. Some limit the number of injurious caterpillars, in which they lay their eggs, and which are fed on by the pupæ. Others free the air from pestilential exhalations by feeding on carrion and putrescent matters[1].

Family IX. *Pupiparæ*. Haustellum of three unequal setæ, exsertile from an aperture at the lower part of the head; at the sides of the retractile haustellum two laminæ, inarticulate, pilose, porrect. Antennæ very short, biarticulate, or with a single pilose joint. Head received behind in the emarginate thorax, or resembling a tubercle set upon the thorax. Feet short, strong, remote, furnished with two incurved claws. Wings divaricate, sometimes very short; in some, together with the poisers, entirely wanting. Body depressed, covered with a hard and elastic skin.

Pupiparous insects suck the blood of mammals and birds. The buccal organs pass as fine threads through a small opening (just like

[1] It is however somewhat hyperbolical, when Linnæus says of *Musca vomitoria*: "*Tres muscæ consumunt cadaver equi, æque cito ac leo.*" *Syst. Natur.* Ed. XII. I. p. 990.

a thread through the eye of a needle, WESTWOOD). These threads are very long in *Melophila* and *Ornithomyia*, shorter in *Hippobosca*. Two oblong hairy plates project like a beak and cover the base of the threads when they are exserted. Are these parts to be regarded as *maxillæ*, or as *palpi maxillares*? The mechanism of the sucker is much more conformable to that of certain *Acarina* than to the proboscis of the rest of the *Diptera*.

These flies lay no eggs, but are viviparous. That which seems to be an egg laid by these insects, and which is sometimes as big as the abdomen of the mother, ought rather to be regarded as a pupa; from it the perfect insect (*imago*) comes to view after an interval of time, dependent upon the temperature to which the pupa is exposed.

The intestinal canal of these insects is very long, and surpasses the length of the body eight or nine times. This length is caused principally by the stomach, or that part of the intestinal canal which precedes the insertion of the *vasa urinaria*, and which presents many tortuosities. The *testes* are two long and very tortuous canals; the ovaries, two oval sacs; near the oviducts are two secretory glands, consisting of very numerous branches, together with two more simple *receptacula seminis*, of which the form varies in different species. The lowest part of the two ovaries opens into a wide sac (*uterus, matrice* LÉON DUFOUR), in which the embryo resides until it comes forth as a pupa. The nervous system has, besides the cerebral ganglion, only a single round ganglion in the thorax, from the posterior margin of which the nerves of the abdomen arise.

Comp. on the anatomy of this family, LÉON DUFOUR, *Rech. anatomiques sur l'Hippobosque, Ann. des Sc. nat.* VI. 1825, pp. 299—322. Pl. 13: also his *Études anatomiques et physiologiques sur les Pupipares, Ann. des Sc. nat.* troisième Sér. *Zool.* Tom. III. 1845, pp. 49—95. Pl. 2, 3.

Phalanx I. *Nycteribiidæ*. Head small, placed at the upper part of the thorax like an obconical tubercle. Thorax semiorbicular. Wings and poisers none. Feet long, with first joint of tarsus very long, and last supplied with two claws incurved, dentigerous at the base, and with two oval appendages.

*Nycteribia* LATR.

Sp. *Nycteribia vespertilionis, Acarus vespertilionis* L., *Phthiridium vespertilionis* HERM., *Mém. apterol.* Pl. v. fig. 1; *Nycteribia Latreillii* WESTW.,

LATREILLE *Hist. nat. d. Crust. et des Ins.* Tom. XIV. Pl. 92, f. 14, and other larger species on foreign bats. According to LÉON DUFOUR there are only two simple eyes, *Ann. des Sc. nat.* Tom. XXII. p. 374; in foreign species two simple eyes occur on each side. NITZSCH has observed that these insects are true *pupiparæ*, like *Hippobosca* (SCHWEIGGER'S *Jahrbuch der Chemie u. Physik*, Bd. XVI. 1826, 4. s. 436). Comp. on this genus J. O. WESTWOOD, *Transact. of Zoolog. Soc.* I. 1835, 4to, pp. 275—294. Pl. 36. All the species of this genus live on bats.

Phalanx II. *Hippoboscidæ* (*Coriacea* LATR.) Head received in the emarginate thorax. Wings divaricate or incumbent, in some very small or none. Last joint of tarsus the longest of all.

*Braula* NITZSCH. Eyes and ocelli none. Wings none.

Sp. *Braula cœca* NITZSCH, GERMAR *Magaz. der Entom.* III. pp. 314, 315; AHRENS, *Faun. Ins. Europ.* Fasc. VI. Tab. 25; RÉAUM. *Mém.* V. Pl. 38, figs. 1—4; this small insect lives parasitically on bees; the metamorphosis is unknown. Is this its place?

*Melophila* NITZSCH, *Melophagus* LATR. Eyes small, ocelli none. Wings and poisers none.

Sp. *Melophila ovina*, *Hippobosca ovina* L., FRISCH, *Beschreib. von allerl. Ins.* V. s. 40. 4. Tab. 18; PANZER, *Deutschl. Ins.* Heft 51, 14; GURLT, *Magaz. f. d. gesammt. Thierheilk.* 1843, IX. Tab. 1, fig. 15. The *sheep-louse* is a wingless fly; RAMDOHR has given a description and figure of its digestive organs; and LYONNET in his posthumous works a careful and elaborate picture of its structure, especially as concerns the external parts; *Recherches sur l'Anatomie et les métamorph.* &c. pp. 1—27, Pl. 1—3. There are two small oblong eyes each consisting of a hundred round façettes remote from each other, (groups of simple eyes?)

Sub-genus *Lipoptena* NITZSCH., (Spec. of *Melophagus* LATR., MEIG.) differs from the preceding by very short rudiments of wings, by distinct poisers, by moderate eyes.

Sp. *Pediculus cervi* L., FABR., PANZER, *Deutschl. Ins.* Heft 51, Tab. 15.

*Ornithomyia* LATR., NITZSCH. (Spec. of *Hippobosca* L., and FABR.) Eyes distinct; ocelli usually three in vertex. Wings distinct. Tarsi with tridentate claws.

Sub-genera: *Anapera* MEIG. (*Oxypterum* LEACH.) Eyes none, wings short, acuminate.

*Stenopteryx* LEACH, MEIG. With three ocelli, wings very narrow, longer than the abdomen.

*Ornithomyia* LEACH, MEIG. With three ocelli, wings incumbent, obtuse.

Sp. *Ornithomyia hirundinis, Hippob. hirundinis* L., *Stenopt. hirundinis* LEACH, MEIG., GUÉRIN *Iconogr., Insect.* Pl. 104, fig. 7: on the common Swift, *Cypselus murarius.*

*Strebla* WIEDEMANN. Eyes very small, triangular. Ocelli? Wings incumbent, rotundate, longer than the abdomen, with parallel veins.

Sp. *Strebla vespertilionis* WIEDEM., *Aussereurop. zweiflug. Ins.* II. Tab. X. fig. 13; on a bat of South America.

*Hippobosca* LATR. *Nirmomyia* NITZSCH. (Species of *Hippobosca* L.) Eyes distinct, large; ocelli none. Wings parallel, incumbent, obtuse, multinervose. Tarsi with bidentate claws.

Sp. *Hippobosca equina* L., CUV. *R. Ani. éd. illustr., Ins.* Pl. 182, fig. 1; PANZER, *Deutschl. Ins.* Fasc. 7, Tab. 23; GURLT, *Magaz. f. d. gesammt. Thierheilk.* IX. Tab. 1, figs. 13, 14; *mouche Bretonne, mouche d'Espagne, Pferde-laus, Forest-fly;* thorax dark-brown, spotted with yellow; abdomen brown-grey, hairy. This species sucks the blood of horses, and attaches itself especially to the belly and the inside of the hind legs.

If we were told that a bird laid an egg that produced a young one as large as the mother, we should think the account fabulous and ridiculous; the fabulous part would not be diminished were the bird ever so small or even a winged insect. Of this insect however the story is accurately true. Let the reader consult the beautiful and circumstantial natural history of this fly which RÉAUMUR has recorded. *Mém. pour servir à l'Hist. des Ins.* VI. pp. 569—608. Pl. 48.

Sub-genus *Olfersia* WIEDEM. (*Feronia* LEACH.)

Family X. *Athericera.* Antennæ with two joints or three, the last undivided, and presenting the form of a patella or capitulum, and in most supplied with a seta or spicate appendage. Proboscis retractile or slightly prominent, with haustellum composed mostly of two, sometimes of four setæ; in some the mouth is closed, with tubercles in place of proboscis. Pupa coarctate.

The name *Athericera* (from ἀθήρ, *spica, arista*), *aristate* or *awned antennæ*, expresses the character by which this family of *Diptera* is distinguished. The larva has in this and the following family a soft, ringed, somewhat conical, anteriorly pointed body. Progression is effected by extension and contraction of the body, whose form is very variable. On the whole the larva does not change its skin, and has no feet; in that of *Helophilus* and *Eristalis* alone are there seven pairs of membranous feet provided with small hooks, on the body beneath, which is the only example of such appendages in this

order[1]. The most have no proper head, but a very moveable mouth well adapted for extension, and two horny hooks curved downwards. The skin of the larva when it changes to a pupa is not cast, but becomes hard, and is changed into the covering of the pupa; the anterior extremity becomes thicker and rounder, and the whole recalls the form of an oval keg. The perfect insect, by moving its head, which is extended forward like a bladder, breaks this shell at its upper extremity, whilst a piece of it springs open like a lid.

Few genera of this family are in the perfect state carnivorous, most of them living on flowers and plants.

Phalanx I. Proboscis in some very short, in others none, in place of proboscis and palps three tubercles (*Œstrus* L.)

Larvæ parasitic, some living beneath the skin, others in the frontal sinuses, or in the intestinal canal of mammalia.

*a*) Proboscis small.

Genera: *Cephenemyia* Latr., *Cuterebra* Clark, Latr., *Trypoderma* Wiedemann.

*b*) Proboscis none.

Genera: *Hypoderma* Clark, (*Œstrus* Meig.), *Œdemagena* Clark, *Cephalemyia* Clark, *Colax* Wiedem., *Œstrus* Clark, (*Gastrus* Meig.)

*Note.*—Antennæ triarticulate, with seta naked in most, in *Cuterebra* plumose. *Gastrus* Meig. differs from *Œstrus* Meig. by the naked poisers, and wings without a transverse nervure at the apex.

Comp. Clark, *Observ. on the genus Œstrus, Trans. of the Linn. Soc.* III. 1796, p. 289, &c.; the same, *An Essay on the Bots of Horses*, &c., London, 1815, 4to, with fig.; the same, *On the Insects called* Oistros *by the Ancients, Trans. Linn. Soc.* XIX. 2. 1843, pp. 81—94.

A. Numan *Waarnemingen omtrent de horzelmaskers, welke in de maag van het paard huisvesten*, Amsterdam, 1834, 4to, mit pl.

J. L. C. Schrœder van der Kolk, *Mémoire sur l'Anatomie et la Physiol. du Gastrus equi*, Amsterdam, 1845, av. pl.

Sp. *Œstrus equi* Fabr., *Gastrus equi* Meig., Guérin, *Iconogr., Ins.* Pl. 101, fig. 5, Clark, *Essay on the Bots*, Pl. 1. figs. 13, 14, (Linnæus described this species under the name of *Œstrus Bovis*). About 5 lines long, body

[1] In these Bouché has frequently observed a moulting; *Beiträge zur Insektenkunde*, in *Nov. Act. Acad. Cæs. L. Car.* Tom. XVII. 1. 1835, p. 498.

hairy, yellow, thorax in the middle black, wings with a brown-grey, transverse stripe in the middle and two similar spots at the point; the female has a long black ovipositor at the end of the abdomen. This fly lays her yellow eggs in various situations on the hair of the horse, to which they remain firmly attached by a glutinous fluid. The young larvæ come from the eggs, which spring open by a lid, as very long and active little worms, and are conveyed by the lick of the horse's tongue into his mouth and gullet (with respect to those eggs which lie beyond the reach of the tongue, we may suppose, with NUMAN, that the larvæ themselves creep to other situations nearer the head). Subsequently the larvæ live in the stomach of the horse, to which they have become attached in very great numbers (several hundreds at once). Here they remain several months, from spring till the beginning or middle of summer, then are detached, being expelled with the excrement, and change into pupæ, from which, after about five weeks, the perfect insect comes to view. This species is found in the horse and ass; besides these, and sometimes simultaneously with them, larvæ also of other species (*Gastrus hæmorrhoidalis* for instance) live in the same resort; the larvæ of this last species are smaller and deep red; see NUMAN, Pl. II. fig. 1.

*Œstrus bovis* FABR., MEIG., GUÉRIN, *Iconogr., Ins.* Pl. 101, fig. 3, CLARK, l. l. Pl. II. figs. 8, 9, CUV. *R. An., éd. ill., Ins.* Pl. 176, fig. 2. The larva of this species lives under the skin of the bullock; that of *Œstrus* (*Cephalemyia*) *ovis* L., GUÉRIN, *Icon. Ins.* Pl. 101, fig. 4, MEIGEN, *Syst. Beschr.* IV. Pl. 38, fig, 16, lives in the frontal sinuses of the sheep[1].

## Phalanx II. Proboscis distinct. Two setæ of haustellum.

### *A. Muscariæ* (species from genus *Musca* L.) Proboscis distinct, membranous, retractile, bilabiate at the point.

Though the Fly genus (*Musca*), thus defined, be much smaller than that of LINNÆUS, it is still a very extensive group, in which the moderns distinguish many genera. Here may be compared ROBINEAU DESVOIDY, *Essai sur les Myodaires, Mém. présentés à l'Acad. des Sc. de l'Institut de France*, Tom. II. 1830, 4to.

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[1] A species is spoken of in man: *Œstrus hominis* (GMEL., *Syst. nat.* Ed. 13, I. p. 2811); comp. KIRBY and SPENCE, *Introduc. to Entomol.* I. pp. 136, 137. Of later observations ISID. GEOFFROY SAINT-HILAIRE has given an account in the *Ann. de la Soc. Entom.* II. p. 518. That larvæ of *Œstrus bovis* and of other *Diptera* may sometimes live under the skin of man is probable from some observations; a few years ago an insect was shewn me that had come out of a boil under the skin in a girl, it was the pupa of a *dipterum*, and agreed very well with that of *Œstrus*. A larva which in many respects resembled that of a *Tachina*, but yet differed from all the species of larvæ of *Diptera* yet known, was observed by Dr SMITT; this larva was pressed from a boil on the head of a girl 6½ years old; see J. J. SMITT and C. J. SUNDEVALL, *Vetersk. Akad. Handlingar*, Stockholm, 1840, pp. 63—68.

*Palps external. Nervures of wings longitudinal only, none transverse.

*Phora* LATR., MEIG. (previously *Trineura* MEIG.) Antennæ inserted at the margin of the mouth, with elongate simple seta. Posterior feet elongate. Wings rotundate, ciliate, with two thick nervures at the outer margin, and three or four others nearly parallel, running obliquely from the second marginal nervure to the posterior margin of the wing. Poisers naked.

Fig. MEIGEN, *Europ. zweif. Ins.* VI. Tab. 63, figs. 1—13; GUÉRIN, *Iconogr., Ins.*, Pl. 104, figs. 3, &c.

Add sub-genera: *Gymnophora* MACQ. and *Conicera* MEIG.

**Palps inserted in the proboscis, retractile and capable of being concealed with it. Nervures of wings longitudinal and transverse. Antennæ inserted in the frons.

*a*) First posterior cellule of the wings open, transverse apical nervure none.

* Poisers naked.

1) Squamæ of the poisers small or none. Head elongato-globose or broad, transverse, with eyes remote.

*Tetanocera* DUMÉR., LATR., MEIG. Antennæ longer than the head, with second joint longest.

*Sepedon* LATR., MEIG., *Baccha* FABR.

*Thecomyia* PERTY., MACQ.

*Loxocera* MEIG., LATR. Antennæ oblique, with third joint longest. Abdomen elongate, sexannulate.

Sp. *Loxocera ichneumonea, Musca ichneumonea* L., PANZER, *Deutschl. Insect.*, Heft 73, Tab. 24, SCHELLENBERG, Tab. 7 &c.

Sub-genus: *Platystyla* MACQ.

*Condylura* FALL., MEIG., LATR. Antennæ shorter than head. Abdomen sexannulate, in males clavate at the apex.

*a*) Seta of antennæ plumose.

Sub-genera: *Lissa* MEIG., *Merodina* MACQ., *Tetanura* FALL., *Chyliza* FALL., *Cordylura* MACQ.

(β) Seta of antennæ simple (naked or pubescent).

Sub-genera: *Cleigastra* Macq., *Myopina* Robin., Macq. (species from genus *Cœnosia* Meig.)

*Scatophaga* Meig., Latr., *Scatomyza* Fall. Antennæ shorter than head. Head barbate beneath. Abdomen quinqueannulate. Wings incumbent, parallel, extending far beyond abdomen.

Add sub-genera: *Dryomyza* Fall., *Sapromyza* Fall., Meig., *Toxoneura* Macq., *Sciomyza* Fall., *Lucina* Meig., *Helomyza* Fall., *Blephariptera* Macq., *Heteromyza* Fall.

Sp. *Scatophaga stercoraria, Musca stercoraria* L., Cuvier, *R. Ani. éd. ill., Ins.* Pl. 178 bis, fig. 10, Réaumur, *Hist. nat. des Ins.* iv. Pl. 27, figs. 1—7 &c.

Comp. J. W. Zetterstedt, *Monographia Scatophagarum Scandinaviæ, Ann. de la Soc. Entomol.* iv. 1835, pp. 175—189, Tab. iv. b.

*Psilomyia* Latr. (*Psila* Meig.)

Add sub-genera: *Oxygma* Meig., *Trigonometopus* Macq., (species from genus *Tetanocera* Meig.,) *Eurina* Meig., *Tetanops* Fall., *Pyrgota* Wiedem., *Otites* Latr., Macq., *Platycephala* Fall., *Dorycera* Meig.

*Ortalis* Fall., Meig.

Sub-genera: *Herina*, Robin., Macq. (*Richardia* Robin., and *Revellia* Robin.,) *Ceroxys* Macq., *Cleitamia* Macq., *Amethysa* Macq., *Notacanthina* Macq., *Ropalomera* Wiedem., *Eurypalpus* Macq., *Platystoma* Latr., *Loxoneura* Macq.

*Trypeta* Meig., *Tephritis* Latr., Fabr.

Add sub-genera: *Ensina, Acinia, Terellia* and *Urophora* Robin., *Petalophora, Senopterina* and *Leptoxyda* Macq., *Bactrocera* Guér., *Dacus* Meig.

Sp. *Trypeta Arctii* Meig., De Geer, *Ins.* vi. Tab. 2, figs. 6—14, Panzer, *Deutschl. Ins.*, Heft 103, Tab. 22; yellow-green body with yellow-brown feet; wings with four transverse brown stripes, which at the external or anterior margin of the wings are united two and two. The larva lives in the flowers and seeds of *Arctium Lappa* and other *Synantheræ*; each pericarp holds only a single larva, which is placed in it head downwards. Other species live in excrescences (like those of gall-nuts) on thistles. The species of this genus are very numerous. The head is broad; the abdomen has five segments, and ends in the female in an ovipositor extended to a point. The wings during life are mostly in a quivering motion and erect; they are usually spotted or striped with darker bands.

*Sepsis* FALL., MEIG. (*Cephalia* MEIG.) Antennæ shorter than head. Head elongate. Eyes rotund. Abdomen quadriannulate, narrow. Wings erect, vibrating.

Sub-genera: *Cheligaster* MACQ., *Nemopoda* ROBIN., *Michogaster* MACQ.

*Diopsis* L. Eyes very remote, the head being produced on both sides into a transverse petiole, oculiferous at its apex, and before the apex antenniferous. Antennæ short, with three joints, the last suborbicular with a long naked seta. Scutellum bispinose, two or four other spines at the sides of the thorax.

Comp. A. DAHL, præside C. LINNÆO *Bigæ Insectorum* 1773, *Amœnitates Acad.* VIII. p. 303. Pl. VI. figs. 1—5 (reprinted in FUESSLY, *Archives de l'Hist. des Ins.* pp. 19, 20, Tab. 6); DALMAN, *Act. Holm.* 1817, *Analect. Entomol.* No. I. (OKEN'S *Isis* 1820); J. O. WESTWOOD, *On Diopsis, Trans. Linn. Soc.* XVIII. 1835, pp. 283—312, pl. See also figures of two species of this genus in GUÉRIN, *Iconogr., Ins.* pl. 103, figs. 8, 9.

LINNÆUS described only one species of *Diopsis* (*Diops. ichneumonea*), now about twenty are known. They are all exotic and from the old world (west coast of Africa, India, Java); *Diopsis brevicornis* SAY, WIEDEM., a species from Pennsylvania, seems not to belong to this genus. According to WESTWOOD there are four setæ in the sucker in *Diopsis Sykesii*, as in *Syrphus*. These small flies by their pediculated eyes remind us of *Podophthalmus* LATR., amongst the *Crustacea*, and of *Zygæna*, amongst the fishes.

*Calobata* MEIG., *Micropeza* LATR.

*Micropeza* FALL., *Calobata* LATR.

*Tanypeza* FALL., *Tæniaptera* MACQ., *Nerius* FABR., WIEDEM.

*Longina* WIEDEM. Antennæ longer than head, with first joint longest.

*Thyreophora* LATR., MEIG.

*Actora* MEIG.

*Coelopa* MEIG., (*Psalidomyia* DOUMERC).

Comp. DOUMERC, *Mém. sur le* Psalydomyia fucicola, *diptère vivant sur les bords de la mer, Ann. de la Soc. Entom.* II. 1833, pp. 89—93. The male has at the abdomen a forceps almost like that of the *Forficulæ*, but with obtuse and hairy points.

*Ulidia* MEIG., *Mosillus* LATR.

*Gymnopoda* MACQ., *Lipara* MEIG., *Timia* MEIG.

*Lauxania* LATR.

*Pachycerina* MACQ., *Lonchæa* FALL., MEIG., *Terenuyia* MACQ., *Pterodontia* GRAY.

*Celyphus* DALM. Antennæ of the length of the head. Scutellum convex, entirely covering the abdomen.

*Notiphila* FALL., MEIG.

*Ochthera* LATR., *Dryxo* ROBIN., *Dichæta* MEIG., *Hydrellia* ROBIN., *Discocerina* MACQ., *Trimerina* MACQ., *Discomyza* MEIG., *Cœnia* ROBIN.

*Piophila* FALL., MEIG.

*Trichomyza* MACQ., *Ephydra* FALL., MEIG., *Anisophysa* MACQ., *Ochthiphila* FALL., *Campichæta* MACQ., *Gitona* MEIG., *Drosophila* FALL., *Stegana* MEIG., *Diastata* MEIG., *Leptopezina* MACQ., *Opomyza* FALL., MEIG., (*Geomyza* FALL.,) *Graphomyzina* MACQ.

*Sphærocera* LATR., *Borborus* MEIG.

*Ceroptera* MACQ., *Crumomyia* MACQ., *Heteroptera* MACQ., *Limosina* MACQ., *Apterina* MACQ., (wings none).

Sp. *Borborus pedestris* MEIG. *Europ. zweifl. Ins.* VI. Pl. 62, fig. 21, two lines long, brilliant black, wingless; this curious insect was discovered by V. WINTHEM near Hamburg.

*Oscinis* LATR., FABR., *Chlorops* MEIG.

*Diasema* MACQ., *Aulacigaster* MACQ., *Leptomyza* MACQ., *Leucopis* MEIG., *Milichia* MEIG., *Gymnopa* FALL., MEIG.; *Siphonella* MACQ., *Homalura* MEIG., *Cnemacantha* MEIG., *Heteroneura* FALL., MEIG., *Therina* MEIG., *Meromyza* MEIG., *Chlorops* MEIG., MACQ., *Oscinis* LATR., MACQ., *Leiomyza* MACQ., *Agromyza* FALL., MEIG., *Phyllomyza* FALL., *Asteia* MEIG., *Elachiptera* MACQ., *Myrmemorpha* DUFOUR.

2) Squamæ of poisers small or moderate. Head sub-globose, with eyes in males (sometimes in both sexes) approximate. (Abdomen quadriannulate). Seta of antennæ inarticulate, often plumose (*Anthomyidæ*).

*Cœnosia* MEIG. Eyes distant, especially in females. Abdomen of male clavate at apex. Wings incumbent.

*Anthomyia* MEIG. Eyes in each sex, or in males, approximate, in last more frequently contiguous. Wings divaricate or incumbent.

Sp. *Anthomyia pluvialis*, *Musca pluvialis* L., GUÉRIN *Iconogr. Ins.* Pl. 102, figs. 9, &c. A very numerous genus.

Sub-genera: *Aricia* ROBIN., *Spilogaster* MACQ., *Hydrophoria* ROBIN., *Hylemyia* ROBIN., *Chortophila* MACQ., *Atomogaster* MACQ., *Eriphia* MEIG. (with eyes contiguous in male).

*Drymeia* MEIG. Lips of proboscis elongate, inflexed, forming a terminal hamate capitulum.

Sp. *Drymeia obscura*, *Musca hamata* PALL., MEIG. *Europ. Zweifl. Ins.* v. Tab. 44, figs. 10—13.

** Poisers obtect.

*Lispe* MEIG. Wings incumbent. Abdomen quadriannulate, oval. Palps dilated at apex, cochleariform. (Habitus of *Anthomyia*. Seta of antennæ plumose. Eyes distant).

*b*) Wings with a transverse apical nervure, closing the first posterior cellule completely or for the most part. Poisers covered with large squamæ. Seta of antennæ with two joints or three (*Creophilæ* LATR.)

Abdomen mostly quadriannulate. Wings often divaricate.

1) *Seta of antennæ plumose.*

*Idia* MEIG., WIEDEM. Head produced beneath into a rostrum above the proboscis.

*Achias* FABR. Head transverse, produced on both sides into a thick oculiferous peduncle. Antennæ short, inserted in the frons.

Sp. *Achias oculatus* FABR., *Syst. antliator.* p. 247, GUÉRIN, *Magas. de Zool.* I. 1831, *Ins.* Pl. 7, CUVIER *R. Ani. éd. ill., Ins.* Pl. 178, fig. 3, Java, and some other smaller species, on which comp. C. R. G. WIEDEMANN, *Achias, Dipterorum genus illustratum novisque speciebus auctum*, cum Tab. 2 lithogr. Kiliæ Holsatorum, 1830, 8vo. This genus is distinguished from *Diopsis* by many characters, by the position of the antennæ, and by the *habitus*.

*Musca* nob. (Spec. of genus *Musca* L.) Head globose, not produced either anteriorly or transversely.

*a*) *Feet moderate. Seta of antennæ plumose to the apex.*

Sub-genera; *Curtoneura* MACQ., *Mesembrina* MEIG., *Pollenia* MACQ., (*Pollenia* ROBIN. and *Nitellia* ROBIN.), *Musca* MACQ., *Calli-*

*phora* MACQ., (*Calliphora* ROBIN., *Mufetia* and *Melinda* ROBIN.), *Lucilia* MACQ., (*Lucilia* ROBIN., *Phormia* and *Pyrellia* ROBIN.), *Ochromyia* MACQ.

*b*) *Feet moderate. Seta of antennæ naked at the apex.*

Sub-genera: *Onesia* ROBIN., *Cynomyia* ROBIN., *Agria* ROBIN., MACQ. (*Agria, Gesneria, Clyto* ROBIN.), *Sarcophaga* MEIG., *Phrissopodia* MACQ.

*c*) *Feet elongate.*

Sub-genera: *Dexia* MEIG., *Prosena* SAINT-FARGEAU and SERV., *Dinera* ROBIN., *Scotiptera* MACQ., *Rutilia* ROBIN.

To the division *a*) the common house-fly *Musca domestica* L., belongs, SCHELLEN. Tab. I., J. C. KELLER *Geschichte der germeinem Stuben-fliege, mit 4 Kupfertafeln.* Nürnberg, 1764, 4to. The larvæ live especially in horse-dung, and these insects are only found in the neighbourhood of human habitations. In a month's time one generation succeeds another, for the larva is full grown in fourteen days; the fly also after fourteen days comes from the pupa, and the egg has only to lie a single day before the young maggot creeps out. Hence it is that they multiply so astonishingly, and that in warm summers, especially at the beginning of autumn, they may prove so numerous. In the open country and on the roads various species of fly are met with of the same size, which are usually confounded with them, as *Musca corvina* FABR., PANZER *Deutschl. Ins.*, Heft 60, Tab. 13, *Musca nigripes* male, Heft 105, Tab. 13, *Musca ludifica* fem. Also the unspotted, gold-green glistering *Musca cæsar* L., the blue flesh-fly *Musca vomitoria*, L., (*Calliphora fulvibarbis* ROBIN.), ROES. *Ins.* II. *Mus. et Culic.* Tabs. IX. X., PANZER *Deutschl. Ins.* Heft X. Tab. 19, which has a shining blue abdomen with black stripes, the head black with red-brown palps. This fly has a fine sense of smell, and readily penetrates into houses in summer to lay its eggs on meat in kitchens and larders. The same applies to those belonging to the

Division *b*) *Musca carnaria* L., (*Sarcophaga carnaria* MEIG.,) RÉAUM. *Ins.* IV. Tab. 28, figs. 2, 8, DE GEER *Ins.* VI. Tab. 3, figs. 5—18, CUV. *R. Ani. éd. ill., Ins.* Pl. 178, fig. 2; still larger than the former, abdomen grey with black spots; black antennæ and palps. It has been estimated that the progeny of a single female of this species may in one summer amount to more than 500 millions of flies[1].

2) *Seta of antennæ downy or naked* MEIG. (Species of *Thereva* FABR.)

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[1] MEIGEN *Syst. Besch. der Eur. Zweiflug. Ins.* V. s. 21, "*Hätte die Natur also Keine mächtigwirkenden Gegenanstalten zur Vertilgung getroffen.... so würde dieses Herr den Menschen wohl wenig Fleisch übrig lassen, und die Fastentage würden stets an der Tagesordnung sein!*"

*Phasia* LATR. Antennæ short, the third joint a little longer than the second. Abdomen depressed, downy, quinqueannulate. Wings divaricate, broad, often coloured, thickish.

Fig. SCHELLENB. Tab. II. fig. 2; GUÉR. *Iconogr. Ins.* Pl. 102, fig. 4.

Sub-genera: *Hyalomyia, Alophora, Elomyia* ROBIN.

*Trichopoda* LATR.

*Xysta* MEIG. Antennæ short, two last joints sub-equal. Abdomen convex, oval with five rings or six, pubescent or sub-nude. Wings lanceolate, divaricate.

*Gymnosoma* MEIG. Antennæ moderate, with two last joints sub-equal. Abdomen quadriannulate, globose, sub-nude.

Sub-genera: *Cistogaster* LATR., *Strongygaster* MACQ.

*Ocyptera* LATR. Antennæ moderate, with third joint longer than second, linear, compressed. Abdomen elongate, subsetose, quadriannulate.

*Phania* MEIG. Antennæ moderate, third joint elongate, linear, compressed. Abdomen oval, subsetose, quadriannulate, inflexed towards the extremity.

*Lophosia* MEIG. Antennæ moderate, third joint the largest, compressed, obtrigonal. Abdomen cylindrical, quadriannulate, subsetose.

*Curtocera* MACQ.

*Tachina* MEIG., *Echinomyia* DUMÉR. Antennæ moderate or short, with second joint often long, sometimes exceeding the third; triarticulate seta at the base of the third joint. Abdomen conical or oval, quadriannulate, setose.

A numerous genus, which beyond any other gives us an idea of the inexhaustible riches of nature in the forms and modifications of animal organisation. MEIGEN counts more than three hundred species which are found in Europe, and of the foreign species, yet known so fragmentarily, still more than a hundred have been described. In some, as for instance in *Tachina grossa*, the second joint of the antennæ is much larger than the last (see DE GEER *Ins.* VI. Pl. I. fig. 2); to such species LATREILLE applies exclusively the name of *Echinomyia*, to which accordingly *Tachina larvarum* does not belong, and which only answers to a small part of the *Tachinæ* of MEIGEN.

The larvæ of these flies live parasitically in other insects, many species in caterpillars, and, with the ichneumons, are the most serviceable in preserving a balance in the economy of nature, by restraining the excessive multiplication of noxious insects. Many are viviparous. Comp. C. TH. VON SIEBOLD, *Ueber die weibliche Geschlechtsorgane der Tachinen*, WIEGMANN'S *Archiv f. Naturgesch.* 1838, s. 191—201. Some larvæ leave the insect in which they live before changing into pupæ.

Sp. *Tachina fera, Musca fera* L., PANZER *Deutschl. Ins.* Heft 20, Tab. 18, &c.

Sub-genera: *Echinomyia* DUMÉR., LATR., MACQ., *Micropalpus* MACQ., *Thryptocera* MACQ., *Trixa* MEIG., *Nemoræa* ROBIN., MACQ., *Senometopia* MACQ., *Eurigaster* MACQ., *Masicera* MACQ., *Metopia* (MEIG. previously) MACQ., *Lydella* ROBIN., MACQ., *Tachina* MACQ. *Chrysosoma* MACQ., *Clysia* ROBIN., *Myobia* ROBIN., MACQ., (*Hebia, Melia, Myobia* ROBIN.), *Zophomyia* MACQ., *Cassidæmyia* MACQ., *Sericocera* ROBIN., MACQ., *Philocera* ROBIN., *Melanophora* (MEIG. previously) MACQ.

*Gonia* MEIG. Antennæ with third joint elongate, surpassing the two preceding taken together. Seta of antennæ triarticulate, geniculate.

*Miltogramma* MEIG. Antennæ with third joint elongate, surpassing the two preceding taken together. Seta of antennæ biarticulate, straight. Abdomen oval or conical, in some not setose, downy.

To this genus the observations of C. TH. VON SIEBOLD refer (*Observ. quæd. entomologicæ de Oxybelo uniglume atque Miltogramma conica.* Erlangæ, 1841, 4to); the female of *Oxybelus uniglumis*, a species of *hymenopterum*, digs for each of her eggs a hole in sandy ground, and deposits near it some flies, her booty. In this work she is watched and followed by *Miltogramma conica*, which lurks near the entrance of the hole for an opportunity to slip in with her as she enters, and to fix some young larvæ on the booty, which afterwards penetrate from it into the larva of *Oxybelus*; the reason why the *Oxybelus* does not drag this *Miltogramma* itself into the hole as food for the larva of her egg, is readily explained by this *dipterum* being viviparous, for then she would have drawn in the Trojan horse; and hence these *Tachinariæ* are avoided. LEPELETIER DE SAINT-FARGEAU has made similar observations as well on *Oxybelus* as on *Cerceris*; *Hist. Nat. des Hymen.* 1841, II. pp. 567, 568, 573.

*B.*) *Conopsariæ.* Proboscis exsert, in most filiform, in some cylindrical or conical.

* Wings imperfect, very short, unfit for flying.

*Carnus* NITZSCH.

Sp. *Carnus hemapterus* NITZSCH, GERMAR *Magaz. der Entomol.* III. pp. 305—307, E. F. GERMAR *Faun. Insector. Europ.* Fasc. IX. Tab. 24, 25. An animalcule about the size of a flea; it lives parasitically on *Sturnus vulgaris*. Abdomen is broader in the female, and terminated by an exsert style.

†† Wings adapted for flying.

*Stomoxys* GEOFFR., FABR. Antennæ shorter than head, triarticulate, with third joint longer than rest, compressed, with dorsal seta. Proboscis exsert, geniculate. Abdomen oval, quadriannulate. Wings divaricate.

*Bucentes* LATR., *Siphona* MEIG. Seta of antennæ triarticulate, naked or downy at the apex. Proboscis geniculate at the base and the middle.

The larvæ of this genus live, like those of the Tachinæ, parasitically, in caterpillars; DE GEER *Ins.* VI. pp. 38, 39; *Mouche coudée*, Pl. 2, figs. 19—23.

*Stomoxys* MEIG., LATR. Seta of antennæ biarticulate, naked or plumose. Proboscis horizontal, geniculate at the base alone.

Sp. *Stomoxys calcitrans, Conops calcitrans* L., GEOFFROY *Ins. Paris*, II. Tab. XVIII. fig. 2, SCHELLENBERG, Pl. 17, fig. 1, GUÉRIN *Iconogr. Ins.*, Pl. 101, fig. 8; grey, with abdomen spotted black. This fly fixes itself on the legs of cattle, and in rainy weather, especially at the end of summer, enters our houses and attacks our legs; the uninitiated fancy that the house-flies are then pricking, and so confound this species with *Musca domestica*.

*Myopa* FABR. Antennæ shorter than head, with second joint longer, or second and third sub-equal, the third ovate or globose, stylate at the back. Proboscis exsert, geniculate. Abdomen elongate, inflected downwards. Wings parallel, incumbent. Ocelli three.

*Zodion* LATR. Proboscis geniculate at the base alone.

*Myopa* LATR. Proboscis geniculate at the base and the middle.

Add sub-genera: *Stachynia* MACQ. (*Dalmannia* ROBIN.), *Stylogaster* MACQ.

*Conops* L., (exclusive of species). Antennæ porrect, of length of head, with first joint cylindrical, second and third forming a fusiform club. Style of antennæ apical, biarticulate. Proboscis exsert, geniculate at the base. Abdomen elongate, sexannulate, inflected. Wings parallel, incumbent. Ocelli none.

Sp. *Conops flavipes* L., DUMÉR. *Consid. gén. s. l. Ins.* Pl. 46, fig. 4, PANZER *Deutschl. Ins.*, Heft 73, Tabs. 21, 22, &c.

Phalanx III. Proboscis distinct, bilabiate at apex. Four setæ of haustellum, an upper (*labrum*) fornicate, emarginate at the extremity, two lateral (*maxillæ*) linear, supplied with a palp incrassated towards the extremity. *Syrphidæ.*

These diptera, which for the most part were placed by LINNÆUS in his genus *Musca*, form the genus *Syrphus* FABR., and numerous small genera of more modern writers.

A. Antennæ of the length of the head, or longer than the head.

† Antennæ with apical style.

*Ceria* FABR. Antennæ inserted on a common frontal pedicle. Abdomen cylindrical.

*Callicera* MEIG., LATR. Antennæ inserted on a common tubercle. Abdomen conical.

†† Antennæ with dorsal seta.

*Psarus* LATR., FABR., MEIG. Antennæ inserted on a common frontal pedicle.

*Chrysotoxum* MEIG., LATR. Antennæ inserted on a conical frontal tubercle. Scutellum unarmed. Wings divaricate.

Sp. *Chrysotoxum arcuatum*, *Musca arcuata* L., GUÉRIN *Iconogr., Ins.* Pl. 99, figs. 6, &c.

*Ceratophya* WIEDEM.

*Microdon* MEIG., *Aphritis* LATR. Antennæ inserted on a small frontal tubercle, little distinct, with first joint elongate, cylindrical. Scutellum bidentate.

Sp. *Microd. apiformis*, *Musca apiformis* DE GEER, GUÉRIN *Iconogr. Ins.* Pl. 100, fig. 1; *Micr. mutabilis*, *Musca mutabilis auctor.* (in part); the larva of this species is, according to the investigations of SCHLOTHAUSER, the same animal which VON SPIX and VON HEIJDEN have described as a slug, under the name of *Scutelligera* and *Parmula*, OKEN'S *Isis*, 1840, s. 922, 923.

*Paragus* LATR., MEIG. Antennæ inserted on the frons, approximate, of the length of the head. Abdomen elongato-quadrate, depressed. Wings parallel, incumbent.

Sp. *Paragus bicolor*, *Syrphus bicolor* FABR., GUÉRIN, *Iconogr. Ins.* Pl. 99, figs. 5, &c.

B. Antennæ shorter than head.

† Proboscis moderate.

*a*) Wings congruous, parallel, incumbent.

*Milesia* LATR., FABR. Antennæ with naked dorsal seta. Nasal tubercle none. Abdomen mostly elongate, narrow.

*Eumerus* nob. (*Eumerus* MEIG., *Xylota* ejusd., *Ascia* ejusd., *Sphegina* ejusd., *Merodon* ejusd.) Hinder thighs incrassated, spinose beneath.

Sp. *Milesia* (*Xylota* MEIG.) *pipiens*, *Musca pipiens* L., PANZER *Deutschl. Ins.* Heft 32, No. 29, SCHELLENBERG, Tab. X. figs. 3, &c.

*Milesia* MEIG. (*Pipiza*, *Psilota* ejusd.) Feet simple; posterior thighs little or not at all thicker than anterior.

*Triglyphus* LOEW. (OKEN'S *Isis*, 1840, p. 565.)

*Syrphus* LATR. Antennæ with dorsal seta naked or downy. Nasal tubercle.

* With abdomen elongate, attenuate anteriorly, clubbed at the apex.

Sub-genus: *Baccha* MEIG.

** With abdomen oval, depressed.

Sub-genera: *Chrysogaster* MEIG., and *Syrphus* ejusd.

Sp. *Syrphus pyrastri*, *Musca pyrastri* L., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 50, fig. 10; *Syrph. ribesii*, *Musca ribesii* L., CUV. *R. Ani. éd. ill.*, *Ins.* Pl. 174, figs. 6, &c.

This pretty family of flies, mostly adorned with yellow transverse bands, often continue hovering in the air in the same place, moving their wings with very rapid vibrations, and producing a peculiar hum in a high note. Their larvæ, conical and pointed forwards, feed on plant-lice. See GOEDÆRDT *Metamorphosis naturalis*, Medioburgi, 12mo, I. p. 99, *Observ.* 47, RÉAUMUR *Ins.* III. Pl. 30, &c.

*Note.*—Sub-genus *Platycheirus* SAINT-FARG. and SERV., with anterior *tarsi* dilated in the male. Comp. STÆGER in KROYER'S *Naturhist. Tidsskr.* IV. 1843, p. 321.

*Sericomyia* MEIG. Antennæ with plumed dorsal seta. Nasal tubercle.

*b*) Wings congruous, divaricate or deflected.

*Helophilus* MEIG. (with the addition of several species of genus *Eristalis* ejusd. and *Mallota* ejusd.) Antennæ with dorsal seta naked or downy. Abdomen oval or conical.

Sp. *Helophilus tenax, Musca tenax* L., PANZER *Deutschl. Ins.*, Heft 14, Nos. 23, 24, SCHELLENBERG, Tab. 9, fig. 1; common with us towards autumn, and often mistaken by the uninformed for bees or wasps. The larva leaves its hiding place in August and September, to undergo its metamorphosis in chinks of walls. The body of the larva of this and of other species ends with a long tail; hence the French name *Vers à queue de rat;* they live in cavities of stems of trees in which water is collected, in cesspools and necessaries, and breathe by this tail. See GOEDÆRDT *Metam. Nat.* I. *Observ.* 2, p. 20, Tab. II.; SWAMMERDAM *Bijb. d. Natuur.* pp. 644—646, Tab. 38, fig. 9; RÉAUMUR *Ins.* IV. Pl. 20, &c.

*Volucella* GEOFFR. *Syrphus* FABR. Antennæ with dorsal seta plumed, mostly long. Abdomen oval or conical, thick, hirsute.

Sp. *Volucella intricaria, Syrphus intricarius* (and *Syrph. bombyliformis* FABR.), *Musca intricaria* L., PANZER *Deutschl. Ins.*, Heft 59, Nos. 11, 12, &c.

The larva of one species, of which the metamorphosis is known, lives in the nests of *Bombus*, and feeds on its larvæ; this is *Volucella zonaria, Syrphus inanis* FABR., RÉAUMUR *Insect.* III. pp. 482—485, Pl. 33, figs. 15—19. The body of this larva is pointed before, broad behind, with six rays disposed in a semicircle. They are also found in wasps' nests.

*Pelicocera* HOFFMANNSEGG, MEIG. Antennæ with short dorsal seta, incrassate, triarticulate.

*c*) Wings more than twice the length of the abdomen (incumbent, parallel).

*Brachyopa* HOFFMANNSEGG, MEIG.

†† Proboscis elongate (of the length of head and thorax). Head porrect beneath into a conical beak.

*Rhingia* SCOP., FABR. Wings incumbent, parallel.

Sp. *Rhingia rostrata, Conops rostrata* L., PANZER *Deutschl. Ins.*, Heft 87, No. 22, DUMÉR. *Cons. gén. s. l. Ins.* Pl. 47, fig. 7.

Family XI. *Tanystomata.* Antennæ mostly with three joints, the last setigerous. Proboscis exsert, containing an haustellum composed of four or six setæ.

*Longbeaks.* The larvæ resemble oblong worms, and have no feet; they have ordinarily a horny and hard, others a soft head, but which is constantly provided with hooklets or retractile appendages, of which they make use in gnawing or sucking their food. The most live underground. They moult before changing into

pupæ; the pupæ are naked, and shew many parts of the perfect insect. LATREILLE, CUV. *R. Ani.* sec. éd. v. p. 455.

A. Setæ of haustellum four.

Phalanx I. Proboscis shorter, terminated by two large labia.

*Scenopinus* LATR. Antennæ triarticulate, with third joint elongate, sub-cylindrical, truncate, no seta. Wings incumbent, parallel.

Sp. *Scenopinus fenestralis*, GUÉRIN *Iconogr. Ins.* Pl. 96, figs. 8, &c. A genus of uncertain place. The larva of *Scenopinus senilis* which BOUCHÉ described, linear, supplied with few hairs, acuminate at both ends like the larva of *Thereva*, and the naked nymph (not a coarctate pupa), sufficiently prove the genus to differ from the division of the *Muscæ*. *Naturg. der Ins.* 1834, Tab. IV. figs. 21, 23.

*Pipunculus* LATR. Antennæ triarticulate, the first joint the least, the third ovate, compressed, with erect seta at the base. Head globose. Wings large, incumbent, parallel.

*Platypeza* MEIG. Antennæ triarticulate, with third joint ovate, compressed, and a terminal seta. Head globose, with eyes in male contiguous. Wings large, parallel, incumbent. Hind feet thicker.

The larvæ live in *Agarici*. See the larva and pupa of *Plat. holosericea* figured by LÉON DUFOUR, *Ann. des Sc. nat.* 2e Série, XIII. Pl. III. figs. 24—26.

*Callomyia* MEIG.

*Dolichopus* LATR. Antennæ with third joint triangular or ovate, and furnished with seta. Abdomen compressed, in males incurved at the apex. Wings incumbent, parallel. Feet long, slender.

Sp. *Dolichopus nobilitatus*, &c.

Sub-genera: *Ammobates* STANNIUS, *Sybistroma* MEIG., *Rhaphium* MEIG., *Porphyrops* MEIG., *Medeterus* FISCH.

Comp. H. STANNIUS *Die Europäischen Arten der zweiflügler Gattung* Dolichopus, OKEN'S *Isis*, 1831, s. 28—68, s. 122—144, s. 248—271; STÆGER *Danske Dolichopoder*, KROYER'S *Tidsskr.* IV. 1843, pp. 1—44.

Sub-genus: *Ortochile* LATR. Proboscis exsert, perpendicular, with palps acute, incumbent.

*Clinocera* MEIG. Antennæ porrect, triarticulate, with terminal incurved seta. Wings incumbent, parallel. Tarsi with three pulvilli.

Comp. MEIGEN, *System. Beschr. der eur. zweifl. Ins.* II. p. 113, Tab. 16, figs. 1—4.

*Leptis* FABR. Antennæ porrect, with third joint setiferous. Palps exsert. Wings divaricate. Tarsi furnished with three pulvilli. Abdomen conical, elongate.

Sp. *Leptis scolopacea, Musca scolopacea* L., SCHELLENB. Tab. 31, Fig. 1, DUMÉR. *Cons. gén, s. l. Ins.* Pl. 48, figs. 1, &c. The larva (BOUCHÉ l. l. p. 44, Tab. IV. fig. 1) lives under ground, and is long and conical. That of another species from France and the South of Europe, *Leptis vermileo, Musca vermileo* L., SCHELLENB., l. l. fig. 2, digs, like the larva of the Lion-ant, funnel-shaped pits in the sand to catch the insects that fall in. See RÉAUMUR *Mém. de l'Acad. royale des Sc. de Paris*, 1753, fig. 402, Pl. 1; DE GEER *Ins.* VI. pp. 168—183, Pl. X; ROMAND *Ann. de la Soc. Entomol.* II. 1833, pp. 498, 499, Pl. 18 c.

Sub-genera; *Atherix* MEIG., *Psiolina* STÆG., ZETTERST.

*Thereva* LATR., MEIG. (*Bibio* FABR.) Palps sheltered in the cavity of the mouth. Antennæ porrect, of the length of the head, with third joint subulate or oblongo-conical, with a small biarticulate terminal style. Wings divaricate. Abdomen conical, tomentose.

Sp. *Thereva plebeia* L., DUMÉR. *Consid. gén. s. l. Ins.* Pl. 48, fig. 2; *Ther. anilis, Musca anilis* L., PANZER *Deutschl. Ins.* Heft 5, Nos. 23, &c.

*Philocephala* ZETTERST.

*Mydas* FABR. (*Midas* WIEDEM.) Antennæ longer than head, quinquearticulate, clavate. Wings incumbent. (Ocellus single, at least in some, frontal, transverse, situated between two exsert rugæ.)

Sp. *Midas filata* FABR., DUMÉR. *Cons. gén. s. l. Ins.* Pl. 48, fig. 8; *Midas giganteus* WIEDEM., CUV. *R. Ani. éd. ill. Ins.* Pl. 172, fig. 2, both from South America. The species, with the exception of a few from Portugal, are all exotic and very large.

Comp. WIEDEMANN, *Nov. Act. Acad. Cæs. Leop. Carol.* XV. 2, pp. 19—56, Tab. II.—IV, 1831, WESTWOOD *Arcana entomologica*, I. 1841, p. 49, Pl. 13, 14. Respecting the place of this genus in the natural arrangement there are different opinions. According to the observations of HARRIS, the larva and pupa agree with those of *Asilus*.

*Note.*—Genus *Cephalocera* LATR., related to Mydas, differs from the other genera of the family by a long, porrect, slender proboscis, yet it ought not to be severed from *Mydas*.

Phalanx II. Proboscis exsert, tubulose. Labia at the end of the proboscis, sometimes scarcely discernible.

† Wings incumbent.

*Asilus* L. Proboscis straight, porrect. Antennæ porrect, approximate, triarticulate, with third joint elongate. Body elongate. Head transverse, above much broader than long, anteriorly barbate, posteriorly separate from the thorax by stricture.

*a*) Tarsi without pulvilli.

*Gonypes* LATR., *Leptogaster* MEIG. Abdomen elongate, narrow. Posterior feet elongate, with clavate tibiæ. Antennæ with biarticulate pilose style at the point.

Sp. *Gonypes cylindricus*, *Asilus tipuloïdes* FABR., SCHELLENB. Tab. XXX. fig. 1.

*b*) Tarsi with two pulvilli.

*) With apical seta of antennæ distinct.

*Ommatius* ILLIG., WIEDEM. Seta of antennæ plumose.

*Asilus* MEIG. Seta of antennæ naked, biarticulate, sometimes clavate.

Sp. *Asilus crabroniformis* L., SCHELLENB. Tab. XXIX, figs. 1, 2, DUMÉR. *Cons. gén. s. l. Ins.* Pl. 46, figs. 10, &c.

Add sub-genus: *Mallophora* MACQ.

**) With style of antennæ conical, short.

*Dasypogon* MEIG.

***) With style of antennæ short, obtuse, biarticulate. Antennæ larger than head.

Sub-genera: *Ceraturgus* WIEDEM., *Dioctria* MEIG.

****) Without apical style of antennæ.

*Laphria* MEIG.

Add sub-genera: *Rhopalogaster*, *Xiphocera* and *Megapoda* MACQ.

*Hybos* MEIG. (*Ocydromia* HOFFMANNSEGG, MEIG.) Antennæ porrect, triarticulate, with the two inferior joints small, often conjoined, scarcely distinct. Proboscis horizontal, short. Head small, globose. Thorax oval, gibbous. Wings large, longer than the cylindrical abdomen.

*Leptopeza* MACQ. (spec. of *Ocydromia* MEIG.)

On the synonomy of certain species comp. STÆGER in KROYER'S *Tidsskrift*, IV. pp. 93—102.

*Œdalea* MEIG.

*Empis* L. Proboscis exsert, perpendicular, or inflected under the body. Last joint of antennæ terminated by a seta or style. Head small, globose.

*a*) With antennæ biarticulate (the two inferior being confluent).

*Tachydromia* MEIG. (*Sicus* LATR.). Anterior thighs incrassate.

Add sub-genera: *Hemerodromia* HOFFMANSEGG, *Drapetis* MEGERLE, *Platypalpus* MACQ. (spec. of *Tachydromia* MEIG.), *Xiphidicera* MACQ., *Ardoptera* and *Elaphropeza* MACQ. (sp. of *Hemerodromia*).

*Cyrtoma* MEIG. Is this its place?

*b*) With antennæ triarticulate.

*Empis* MEIG. (*Empis*, *Pachymerina* MACQ.), *Rhamphomyia* MEIG., *Hilaria* MEIG., *Brachystoma* MEIG., *Gloma* MEIG., *Microphorus* MACQ. (*Trichina* MEIG.)

Sp. *Empis tessellata* FABR., *Empis opaca* FABR., &c.

†† Wings divaricate.

*Cyrtus* LATR. Proboscis inflected under the body. Antennæ approximate. Poisers small, covered by large squamæ. Head small, globose. Thorax gibbous. Abdomen inflated, vesiculose. Tarsi with three pulvilli.

*a*) Proboscis short (sometimes not discernible in the dried insect).

*) With antennæ biarticulate, no style.

*Pterodontia* GRAY.

**) With antennæ biarticulate, and terminal style.

*Henops* ILLIG., FABR., *Ogcodes* (*Oncodes*) LATR., (*Henops* MEIG., *Acrocera* MEIG.)

Comp. ERICHSON *Archiv f. Naturgesch.* 1846, p. 288.

Sp. *Henops gibbosous*, *Musca gibbosa*, L., GUÉRIN *Iconogr.*, *Ins.* Pl. 94, fig. 10.

***) With antennæ triarticulate, no style.

*Astomella* DUFOUR, LATR., *Ocnea* ERICHS., *Pialea* ERICHS.

Sp. *Astomella curviventris* DUF., *Astom. marginata* LATR., LÉON DUFOUR, *Ann. des Sc. nat.* XXX. 1833, pp. 210. 211, Pl. 17 A, fig. 1, antenna. Habitat Spain.

*b*) Proboscis elongate.

*) With antennæ biarticulate; long terminal seta.

*Cyrtus* LATR., MEIG., *Acrocera* MEIG., LATR., *Psilodera* GRIFF., *Thyllis* ERICHS., *Philopota* WIEDEM.

Sp. *Cyrtus gibbus* MEIG., *Cyrtus acephalus* LATR., DUMÉR. *Consid. gén. s. l. Ins.*, Pl. 48, fig. 7, VILLERS *Entom. Linn.*, Tab. X. fig. 21.

**) With antennæ triarticulate, longer than the head, no style.

*Panops* LAM., LATR., *Lasia* WIEDEM.

Sp. *Panops Baudini* LAMARCK, *Ann. du Mus.* III. 1804, pp. 263—265, Pl. XXII. fig. 3, habit. in New Holland; *Panops ocelliger* WIEDEM., GUÉRIN *Iconogr., Ins.* Pl. 94, fig. 9.

Comp. on these genera of *Diptera* ERICHSON *Entomographia*, 1840, pp. 135, &c.

*Bombylius* L. Antennæ porrect, approximate. Proboscis porrect, slender, mostly elongate. Palps uniarticulate. Squama of poisers small, not covering the poisers. Trunk gibbous. Feet slender, elongate.

*a*) Abdomen elongate, narrow.

*Phthiria* MEIG., WIEDEMANN (*Phthiria* and *Megapalpus* MACQ.), *Geron* HOFFMANNSEGG, *Systropus* WIEDEM., *Amictus* WIEDEM., *Apatomyza* WIEDEM., *Thlipsomyza* WIEDEM., *Cyllenia* LATR., MEIG., *Toxophora* WIEDEM., *Xestomyza* WIEDEM.

Comp. *Systropi generis Dipterorum Monographia, auctore* J. O. WESTWOOD, GUÉRIN *Magas. de Zool.* 1842; *Systr. eumenoïdes* WESTW., l. l. Pl. 90.

*Toxophora Carcelii* GUÉRIN, *Magas. de Zool.* I. 1831, *Ins.* Pl. 16.

*b*) Abdomen short. Body hirsute.

*Ploas* LATR., MEIG. Proboscis of the length of the head. First joint of antennæ longer than the rest, very thick.

*Usia* LATR., MEIG., *Bombylius* MEIG., LATR. Proboscis longer than the head (sometimes of the length of the body). Third joint of antennæ longer than the rest.

Comp. J. C. MIKAN *Monographia Bombyliorum Bohemiæ, iconib. illustr.* Pragæ, 1796, 8vo.

Sp. *Bombylius medius* L., *Bombyl. discolor*, MIK., *Monogr.* Tab. II. fig. 1; *Bombyl. tricolor* GUÉR. *Iconogr. Ins.* Pl. 95, fig. 4, from Bengal.

In the proper genus *Bombylius* the body is woolly; they hover over flowers, whilst they suck them, like humming bees (*Bombi*). According to MACLEAY the larvæ live upon larvæ of these bees; the pupæ are found under ground. WESTWOOD, *Introduction*, II. p. 542.

*Nemestrina* LATR. Antennæ porrect, remote, triarticulate, with style elongate, setiform, terminal. Proboscis very long, at rest inflected under the body. Thorax not gibbous. Tarsi with three pulvilli.

Sp. *Nemestrina longirostris* WIEDEM., *Aussereurop. zweifl. Ins.* Tab. II. fig. 5, GUÉRIN *Iconogr., Ins.* Pl. 95, fig. 7; from the Cape of Good Hope. In this species, and in most of the remaining, the point of the wing is divided into many cells (retiform); this is not the case in some others, which make up the genus *Fallenia* MEIG.

*Anthrax* SCOPOLI, FABR. Antennæ small, triarticulate, furnished with terminal style, mostly remote. Proboscis mostly short, sometimes retracted.

*a*) Tarsi with three pulvilli.

*Hirmoneura* WIEDEM., MEIG. Proboscis retracted. Anterior ocellus remote.

*b*) Tarsi with two pulvilli, often little distinct.

*) Proboscis longer than head.

Genera: *Mulio* LATR., *Corsomyza* WIEDEM., *Enica* MACQ.

**) Proboscis short, concealed or subexsert.

Genera: *Lomatia* MEIG. (previously *Stygia* ejusd.), *Tomomyza* WIEDEM. with antennæ approximate.

*Anthrax* MEIG., with antennæ remote.

Sp. *Anthrax morio*, *Musca morio* L.; *Anthr. semiatra* HOFFMANNSEGG, DUMÉR. *Cons. gén. s. l. Ins.* Pl. 48, fig. 4; CUV. *R. Ani. éd. ill., Ins.* Pl. 168, fig. 2. Most of the species are exotic. SCHÆFFER figures the larva and pupa of a species of dipterum that lives as a parasite in the nest of the mason-bee (*Megachile*). *Die Mauerbiene*, Regensburg, 1764, 4to. Tab. V. figs. 11, 12. WESTWOOD quotes these figures under *Anthrax*.

B. Setæ of Haustellum six (in females).

Phalanx III. (*Tabanii* LATR.)

*Tabanus* L. Antennæ porrect, triarticulate, with last joint divided into several rings, without terminal seta or style. Wings

divaricate in by far the most, in some parallel, deflected. Eyes very large, contiguous in males. Tarsi with three pulvilli.

*a*) Proboscis of the length of the head or shorter than the head, bilabiate at apex.

*) Antennæ longer than head.

Sub-genera: *Hexatoma* MEIG., *Hæmatopata* MEIG. Wings deflected, parallel. Ocelli none.

Sp. *Hæmatopota pluvialis, Tabanus pluvialis* L., PANZER, *Deutschl. Ins.* Heft 13, no. 23; four lines long, blackish, thorax with white stripes, wings clouded grey; the female pricks sharply, especially in warm rainy weather; very common all over Europe.

Sub-genera: *Chrysops* MEIG., *Silvius* MEIG. Wings divaricate. Ocelli three.

Sp. *Chrysops cœcutiens, Taban. cœcutiens* L., DUMÉR. *Cons. gén. s. l. Ins.* Pl. 47, fig. 8.

** Antennæ of length of head, (ocelli none, wings divaricate).

Sub-genus: *Tabanus* MEIG.

Sp. *Tabanus bovinus* L., PANZER, *Deutschl. Ins.* Heft 2, no. 20; CUV. *R. Ani. éd. ill., Ins.* Pl. 171, fig. 2, &c. This species has naked eyes; in other species the eyes are haired. Comp. ZELLER in OKEN'S *Isis*, 1842, s. 812—823. The larvæ live under ground: the pupa state lasts in *Tabanus bovinus* about four weeks. DE GEER *Ins.* VI. pp. 214—219, Pl. 12, figs. 6, 7.

*b*) Proboscis elongate (of length of head and thorax), acuminate. (Ocelli mostly three, in some none.)

Sub-genera: *Pangonia* LATR., MEIG. (previously *Tanyglossa* MEIG.), *Rhinomyza* WIEDEM.

Family XII. *Notacantha* s. *Odontomyiidæ*. Antennæ with several joints, four or more being terminal, very often joined to form an annulate body cylindrical or conical. Setæ of haustellum four. Palps small, clavate. Tarsi with three pulvilli. Scutellum in many armed with spines or teeth, whence the family name.

*Thorn-backs, armed flies.* RÉAUMUR gave to some species of this family the name of *mouches armés*, which GEOFFROY (*Hist. des Insectes qui se trouvent aux environs de Paris*, II. 1762, p. 476) rendered by *Stratiomys*, to which name well-founded objections may be made (ZELLER, OKEN'S *Isis*, 1842, p. 828), but since it was adopted by FABRICIUS, it is now in too general use to permit its rejection

without occasioning much confusion. LINNÆUS referred these flies to the genus *Musca*. By their antennæ they approach the last family of the diptera, the *Nemocera*, in which there is constantly found a great number of joints, whilst the rest of the families have ordinarily three alone. At the same time the majority of writers consider the antennæ of the *Notacantha* to be three-jointed in like manner, in which view the last joints are merely noted as rings in the terminal joint. But there is much that is uncertain and arbitrary here. That the *seta* of the *Athericera* may be counted as a joint of the antenna, and that it is not separated by any sharp boundary from a *stylus*, which is itself often jointed also, will be readily admitted by every one who has not studied nature from books alone. The true place of the *Notacantha* in a natural system cannot in any case be far from *Tabanus*, although some only agree with *Tabani* in the metamorphosis, the genus *Pachystomus* for instance (LATREILLE *Genera Crust. et Ins.* IV. pp. 286, 287), the properly so-named *Xylophagi*, and perhaps *Cœnomyia* (see WESTWOOD, *Introd. to modern Classif. of Insects*, II. p. 535). Most of the species, on the other hand, the species of all the genera which establish the essential type of this family, do not cast their skin. Under the skin of the larva, which however does not, as occurs in *Athericera*, contract itself to a ball, the pupa is formed. Some larvæ live underground, others in decayed wood, others in water.

The antennæ are mostly cylindrical or conical, sometimes club-shaped, and seldom longer than the head; this last is a semi-round, of which the eyes in the male occupy almost the whole bulk; there are three ocelli. The body is flat; the wings are long and cross one another, lying flat on the abdomen, and mostly leaving its sides uncovered.

A. Antennæ mostly with ten joints, the last eight confluent into a single subulate body, style none.

† Antennæ not longer than head.

*Cœnomyia* LATR. (*Sicus* FABR.) Scutellum bidentate.

Sp. *Cœnomyia ferruginea* MEIG., *Europ. zweifl. Ins.* II. Tab. 12; DUMÉR. *Cons. gén. s. l. Ins.* Pl. 48, fig. 3.

*Xylophagus* MEIG. Scutellum unarmed.

*Xylophagus* WESTW. First joint of antennæ elongate.

Sp. *Xylophagus ater* MEIG., *Europ. zweifl. Ins.* II. Tab. 12, fig. 14; *Empis subulata* PANZER, *Deutschl. Ins.* Heft 54, no. 23.

The name *Xylophagus* is, according to the observations of DREWSEN, unsuitable, for the larvæ do not feed on wood, but suck those of *Tipula* and *Pyrochroa*, which have the same habitat (old trunks of trees). KROYER's *Tidsskr.* IV. p. 103.

*Note.*—Here is to be referred genus *Pachystomus* LATR., with five joints of antennæ, the last three conjoined. LATREILLE *Gen. Crustac. et Insector.* IV. pp. 286, 287.

*Subula* MEGERLE, WESTW. (spec. of *Xylophagus* MEIGEN). First joint of antennæ short.

(A genus differing from the preceding in the metamorphosis, according to the observations of ROSER, HOPE and others; comp. WESTWOOD *Introduct.* II. p. 534).

*Beris* LATR. Scutellum armed with four, six or eight spines.

Sp. *Beris clavipes* PANZER, *Deutschl. Ins.* Heft 9, no. 19, &c.

*Acanthomera* WEIDEM.

*Raphiorhynchus* WIEDEM.

(This genus with *Acanthomera* is placed by MACQUART amongst the *Tabanii.*)

†† Antennæ longer than head.

*a*) Antennæ simple.

*Cyphomyia* WIED. Scutellum bidentate.

Sp. *Cyphomia auriflamma* WIEDEM., GUÉRIN *Iconogr., Ins.* Pl. 98, fig. 5. Habit. in Brazil. All the species are American; the habitus is that of *Stratiomys*, from which genus they seem to differ by artificial character alone.

*Hermetia* LATR. Last joint of antennæ oval, elongate, set upon the constricted apex of the preceding. Scutellum unarmed.

Species all exotic, mostly American.

*b*) Antennæ flabellate.

*Ptilocera* WIEDEMANN.

Sp. *Ptilocera quadridentata, Stratiomys quadridentata* FABR., WIEDEMANN *Aussereurop. zweifl. Ins.* II. p. 59. Tab. VIII. fig. 4. Habit. in islands Sumatra and Java.

B. Antennæ with joints not more than eight, with long seta terminal or near the apex.

*Sargus* FABR., MEIG. (*Sargus* and *Chrysomyia* MACQ.) Antennæ with last joint orbicular or elliptic. Scutellum unarmed. Wings lanceolate, longer than abdomen.

Sp. *Sargus cuprarius*, *Musca cupraria* L., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 50, fig. 8; with us not rare, four lines long; two white spots on the head at the base of the antennæ, breast blue-green, abdomen copper-coloured, towards the hinder part violet, glistening prettily.—*Sargus formosus*, *Chrysomia formosa* MACQ., &c.

*Chrysochlora* LATR.

Sp. *Sargus amethystinus* FABR., CUV. *R. Ani. éd. ill., Ins.* Pl. 173, fig. 6; on the island Mauritius.

*Dicranophora* MEIG. Scutellum with very long appendage forked at the apex.

Sp. *Dicranophora furcifera*, *Sargus furcifer*, WIEDEM., GUÉRIN *Iconogr., Ins.* Pl. 98, fig. 12; from the Brazils.

C. Antennæ with six or seven joints, furnished with conical terminal style (*Nemotelus* GEOFFR. in part).

*Vappo* LATR., FABR., *Pachygaster* MEIG.

† Proboscis long.

*Nemotelus* MEIG. (Spec. of genus *Nemotelus* GEOFFR., FABR.) Scutellum unarmed.

Sp. *Nemotelus pantherinus* MEIG., PANZER *Deutschl. Ins.* Heft 46, No. 21, 22. (*Nemot. uliginosus* and *marginatus*).

†† Proboscis short.

*Ephippium* LATR., *Clitellaria* MEIG. (*Ephippium* and *Cyclogaster* MACQ.)

*Oxycera* MEIG. Antennæ sexarticulate, cylindrical at apex, with style terminal or dorsal, biarticulate, slender. Scutellum bispinose.

Sp. *Oxycera trilineata* MEIG., *Musca pantherina* L. (*exclus. syon.*), PANZER *Deutschl. Ins.* Heft 1. n. 13; 3 lines long, yellow-green, breast with three black longitudinal stripes, abdomen with black transverse bands on the dorsal surface, feet yellow.

D. Antennæ septarticulate, of length of head or longer than head (with first joint elongate), no terminal seta.

*Stratiomys* GEOFFR., FABR. (exclusive of species.)

*Note.*—The genus *Odontomyia* MEIGEN, afterwards abolished by himself, but preserved by LATREILLE, differs by the shorter antennæ, acuminate at the apex.

Sp. *Stratiomys chamæleon* FABR., MEIG., *Musca chamæleon* L., RÖSEL *Ins.* II. *Muscar. et Culic.* Tab. V. PANZER *Deutschl. Ins.* Heft 8, No. 24, 7 lines long; the scutellum, the feet and under surface of the abdomen yellow, the upper surface of the abdomen black, with three yellow transverse stripes interrupted in the middle, and yellow point. Here are to be referred the observations and descriptions of SWAMMERDAM, *Hist. nat. Ins.* 1669, p. 151, Tab. IV. (under the name of *Tabanus*), and *Bijbel der Nat.* pp. 649—694, Tab. 39 (under the name of *Asilus*). The larva is elongate, pointed at both extremities, with a star-shaped ring of more than twenty feathered filaments at the end; it moves very slowly on the surface of the water.

Family XIII. *Nemocera* or *Tipulariæ*. Antennæ filiform or setaceous, with numerous joints, mostly fourteen or sixteen, never fewer than six. Head small, globose, with large eyes. Proboscis exsert, in some short, terminated by two large labia, in some produced into a rostrum. Palps two, external, inserted at the base of the proboscis, filiform or setaceous.

Thorax large, gibbous. Wings oblong. Poisers naked, with inconspicuous squamæ. Abdomen elongate, composed mostly of nine joints.

Feet long, slender. Pupa incomplete (*nympha*).

*Thread-antennate, Gnat-like.* Many, especially the smaller species, fly in great troops dancing through the air. The females lay their eggs on the water, some on plants, or on the ground. The larvæ are long and vermiform; their body has twelve rings, besides the clearly distinct horny head. The head is provided with manducating oral organs (*mandibles* and *maxillæ*). The *stigmata* are in number and position various. These larvæ constantly cast their skin before changing to pupæ. In the pupa the parts of the insect may be clearly recognised. Almost always these pupæ lie uncovered in the water or under the ground; only in some are they enclosed in a case or web (*Sciara, Mycetophila*). Many of these pupæ are provided with spines or horns, by means of which, about the time of the last changing, they are able to work to the surface of the earth.

This family consists of the Linnæan genera *Tipula* and *Culex*. If the genus of the flies of LINNÆUS, the *Athericera* of the moderns, with short antennæ and tun-shaped pupæ, be considered to be the proper *type* of the two-winged insects, then the insects before us deviate the most from that type, and make the transition to other orders, to some *Neuroptera* (*Phryganea*) and *Lepidoptera* (*Pterophorus*,

*Alucita*). We begin, in enumerating the genera, with those that approximate most nearly to the flies.

A. Proboscis short, thick, terminated by two large labia. Setæ of haustellum in many only two. Palps with four joints, sometimes five, mostly incurved or uniarticulate, straight. *Tipula* L. (*Tipulariæ* or *Tipulidæ* of the moderns).

† Antennæ scarcely longer than head (or at least shorter than head and thorax together), mostly with eleven joints, filiform, moniliform or perfoliate. Wings broad, rounded at the apex.

*Aspistes* HOFFMANNSEGG, MEIG. Antennæ octarticulate, clavate at the apex. Ocelli three.

Sp. *Aspistes berolinensis*, MEIG. *Europ. Zweifl. Ins.* I. p. 319, Tab. XI. fig. 16; one line long, on the leaves of *Tussilago petasites* and the flowers of *Daucus carotta* in North-Germany.

*Bibio* GEOFFR., MEIG., (*Hirtea* FABR.) Antennæ novemarticulate, perfoliate. Ocelli three. Tarsi with three pulvilli. Anterior tibiæ armed with a spine.

Sp. *Bibio Marci*, *Tipula Marci* L., RÉAUMUR *Ins.* v. Pl.; PANZER, *Deutschl. Ins.* Heft 95, No. 20; known amongst us by the name of *black fly*; the larva has ten pairs of air-slits; it lives underground, and passes the winter; the pupa lies in an oblong round cavity of loosely compacted earth; after three or four weeks, early in the spring (in the last half of April), the perfect insect makes its appearance. Comp. LYONET'S observations and figures, *Recherches*, &c., *Ouvrage posthume*, pp. 58—72, Pl. 7. That these flies cause injury to the blossom of apple-trees is a common opinion, but entirely without proof; it is quite untrue, at least, that they lay their eggs in the blossoms. The larvæ, which are found in apple-blossom, are those of a small rostrated beetle, *Anthonomus pomorum*; see P. H. VAN BERCK, *Verhandeling over de zwarte vliegen*, Haarlem, 1807, 8vo.

*Dilophus* MEIG. Antennæ undecimarticulate, perfoliate. Ocelli three. Thorax pectinate, with a double row of denticles.

Sp. *Dilophus vulgaris*, *Tipula febrilis* L.; MEIGEN *Europ. zweifl. Ins.* I. Tab. XI. fig. 1; *Diloph. collaris* GUÉR., *Iconogr. Ins.* Pl. 93, fig. 7, South America, &c.

*Plecia* HOFFMANNSEGG, MACQ.

*Penthretria* MEIG., LATR. Antennæ undecimarticulate, perfoliate. Ocelli three. Palps exsert, incurved, quadriarticulate. Feet unarmed, long.

*Scatopse* GEOFFR., MEIG., FABR. Antennæ undecimarticulate, perfoliate. Ocelli three. Palps very small, with a single joint.

Sp. *Scatopse notata, Tipula notata* L., MEIGEN *Europ. zweifl. Ins.* I. Tab. X. fig. 13; DE GEER *Ins.* VI. Tab. 28, figs. 1—4, &c.

*Simulia* MEIG., *Simulium* LATR. Antennæ undecimarticulate, moniliform, cylindrical or fusiform. Ocelli none. Palps quadriarticulate.

Small, but very troublesome species, with oral organs developed as in the genus *Culex* (according to the observations of CURTIS, cited by WESTWOOD, *Introd.* II. p. 558), but shorter. With these they prick, which the *Tipulæ*, on the contrary, do not. In the south of Hungary, in the Banat, *Simulia maculatæ, Musca columbaschensis* GMEL., is sometimes, from the enormous numbers, very troublesome, and even dangerous. Here belongs also *Simulia pertinax* KOLLAR, *Brasiliens lästige Insecten*, fig. 14, which, under the collective name of Musquitos (*Mosquitos, Moustigues*), is joined to the gnats (*Culices*). According to HUMBOLDT, in all the Spanish colonies these last are not called *Mosquitos*, but *Zancudos*. In North America it seems to be the *Culices* which are named *Mosquitos*, whilst the *Simuliæ* are distinguished from them as 'black flies.'

†† Antennæ longer than head, mostly of the length of head and thorax together. Joints of antennæ various, mostly twelve or sixteen.

*Cecidomyia* MEIG. Antennæ with 12 or more joints, filiform, porrect. Ocelli none. Wings incumbent.

The larvæ of many species live in excrescences of plants, like the gall-wasps. Here belong *Cecydomia destructor*, the *Hessian Fly* of the North Americans, and *Cecidomyia tritici* KIRBY in *Linn. Trans.* IV. p. 232, V. p. 96, Tab. 4, fig. 1. By such an insect, *Cecidomyia salicina*, those excrescences also are caused, which are sometimes seen in the form of double roses on the top of willow-branches. SWAMMERDAMM *Bijbel der Natuur.* pp. 749, 750, Tab. XLIV. fig. 16; DE GEER *Ins.* VI. pp. 412—416. Pl. 26, figs. 1—7; *Cecid. Pini.* Comp. RATZEBURG *Forst. Insecten*, III. 1844. Taf. X. fig. 14; ERICHSON'S *Archiv f. Naturgesch.* 1841, s. 233—247. Taf. XI. &c.; LÉON DUFOUR *Histoire des Metamorphoses des Cecidomies*, &c. *Ann. des Sc. nat.*, sec. Sér. Tom. XVI. 1841, p. 257.

*Psychoda* LATR., MEIG. (previously *Trichoptera* MEIG.) Antennæ porrect, moniliform, pilose, multiarticulate. Palps exsert, with four equal joints. Ocelli none. Wings broad, pilose, furnished with many longitudinal nervures.

Sp. *Psychoda phalænoïdes, Tipula phalænoïdes* L., DE GEER *Ins.* VI. p. 422. Pl. 27, figs. 6—9; MACQUART *Diptèr.* I. Pl. 4, fig. 12. This small (1½ line)

ash-grey insect, that resembles a small moth, is found on walls in moist situations; it can turn itself about very cleverly, and springs more than it flies. The larva is dirty yellow, with a black-brown head and awl-shaped horny tail, and lives in decaying vegetable matter. Bouché *Naturgesch. d. Ins.* Taf. II. figs. 20, 21; *Psych. palustris* Meig. Guér. *Iconogr. Ins.* Pl. 92, f. 5, &c.

*Lasioptera* Meig. (*Diomyza* Megerle.)

Sub-genus: *Lasiopteryx* Steph., Westw. (spec. of *Lasioptera* Meig.)

*Zygoneura* Meig.

Sub-genus: *Lestremia* Macq.

*Mycetophila* Meig. Antennæ porrect, cylindrical, sedecim-articulate. Palps incurved, quadriarticulate. Ocelli two or three, unequal, the middle one the least. Tibiæ spurred at the apex, the posterior with spiny sides.

Sub-genera: *Leia* Meig., *Boletina* Stæger, *Sciophila* Hoffmannsegg, *Gnoriste* Hoffmanns.

Comp. H. Stannius *Bemerkungen ueber einige Arten der zweiflügler Gattungen Macrocera, Platyura, Sciophila, Leia, und Mycetophila*, Oken's *Isis*, 1830, pp. 752—758; Stæger, Kroeyer's *Tidsskrift*, III. 1840, pp. 228—288.

*Platyura* Meig. (excl. *Pl. tipuloides.*)

*Ceroplatus* Bosc, Fabr., Latr.

Comp. Bosc *Actes de la Soc. d'Hist. nat. de Paris*, Tom. I. p. 42, &c.; Léon Dufour *Révision et Monographie du genre* Ceroplatus, *Ann. des Sc. nat.* sec. Série. Tom. XI. 1839, *Zool.* pp. 193—213, Pl. 5.

*Cordyla* Meig., Latr. Antennæ duodecimarticulate, compressed, clavate. Ocelli none.

*Sciara* Meig. (*Molobrus* Latr.)

*Campylomyza* Wiedem., Meig.

*Mycetobia* Meig.

*Macroneura* Macq.

*Asindulum* Latr.

*Synapha* Meig.

*Rhyphus* Latr.

*Macrocera* Meig. Antennæ long, setaceous, with the two basilar joints thick, the rest indistinct. Ocelli three. Wings obtuse, parallel, incumbent.

*a*) Antennæ longer than body. Ocelli three, disposed in a triangle, *Macrocera* MEIG.

*b*) Antennæ shorter than body. Ocelli three, placed in a transverse line. *Bolitophila* HOFFMANNSEGG, MEIG.

On the metamorphosis, comp. GUÉRIN, *Mémoire sur un Insecte du genre Bolithophile, Ann. des Sc. nat.* x. 1827, pp. 399—411. Pl. XVIII.

*Chionea* DALM. Antennæ setaceous, with ten joints. Palps with four sub-equal joints. Ocelli none. Body apterous, with poisers.

Sp. *Chion. araneoïdes*, DALMAN *Kongl. Ventensk. Acad. Handb.* 1816, 102; OKEN'S *Isis*, 1824, p. 419, Tab. V.; GUÉRIN *Iconogr., Ins.* Pl. 93, fig. 2; found in Sweden on the snow.

*Anisomera* HOFFMANNSEGG, MEIG. (*Hexatoma* LATR., *Nematocera* MEIG.) Antennæ very long, setaceous, with first joint cylindrical, second short, cup-shaped, third elongate, filiform. Palps with four equal joints. Wings incumbent.

*Megistocera* WIEDEM.

*Dixa* MEIG.

*Macropeza* MEIG.

*Trichocera* MEIG.

*Polymera* WIEDEM.

*Limnobia* MEIG. Antennæ setiform, joints 15—17; first joint cylindrical, second cup-shaped, rest oblong or globose. Palps with four equal joints. Ocelli none. Wings incumbent, parallel, with nervures naked or pilose (*Erioptera* MEIG.)

Add sub-genera: *Symplecta* MEIG., *Cylindrotoma* MACQ. (antennæ with thirteen cylindrical joints), *Limnophila* MACQ., *Idioptera* MACQ., *Rhamphidia* MEIG., MACQ.

Sp. *Limnobia picta*, *Tipula picta* FABR., SCHELLENBERG Tab. 38, fig. 1; GUÉRIN *Iconogr., Ins.* Pl. 92, fig. 9 (named *Limnobia ocellaris*), &c. Comp. T. E. SCHUMMEL, *Beschreibung der in Schlesien einheimischen Arten von Limnobia, Beiträge zur Entomologie* I. Breslau, 1829, 8vo, s. 97—201. Tab. 1—5; B. STANNIUS *zur Verwandlungsgesch. der Limn. Xanthoptera, ibid.* s. 202—206.

*Rhipidia* MEIG.

*Ozodicera* MACQ.

*Tipula* (Sp. of *Tipula* L.) Antennæ filiform or setaceous, with 13 joints, the first elongato-cylindrical, second cup-shaped, short, the rest cylindrical, pilose. Palps incurved, with last joint longer than the rest, cylindrical, annulate or nodose. Ocelli none. Wings divaricate.

Sub-genera: *Pachyrhina* Macq., *Tipula* ejusd.

*Ctenophora* Meig. (antennæ pectinate in male).

In this division are found the largest species of *Nemocera*, for instance, *Tipula præpotens* Wiedem. from the island of Java, whose body is 16 lines long, and the slightly smaller European *Tipula gigantea* Schrank, Schellenberg, *Dipt.* Tab. 36, Cuvier *R. Ani. éd. ill., Ins.* Pl. 162, fig. 5; *Tipula oleracea* L., De Geer *Ins.* vi. Pl. 18, figs. 12, 13; *Tipula crocata* L., Villers *Entomol. Linn.* Tab. ix. fig. 2, dull black, with a yellow ring behind the head, yellow spots on the thorax, and three orange-coloured rings on the first part of the abdomen; wings brownish, with a black spot at the margin; feet dark brown. With this species is often confounded *Tipula flaveolata* F., *Ctenophora flaveolata* Meig., Réaumur *Ins.* v. Tab. i. figs. 14—16; Cuvier *R. Ani. éd. ill., Ins.* Pl. 162, fig. 2, which is easily distinguishable by its thicker and yellow feet, by seven yellow rings on the abdomen, of which one is at the base, and by its shining black, whilst the male, moreover, has plumed antennæ. The larva of this species lives in hollow stems of trees.

*Dictenidia, Xiphura,* Brullé *Ann. de la Soc. Entom. de France,* i. pp. 205—209, Pl. v. Species of *Ctenophora*.

*Pedicia* Latr.

*Nephrotoma* Meig.

*Ptychoptera* Meig. Antennæ with sixteen joints, the third joint long, cylindrical. Last joint of palps very long, setaceous. Ocelli none. Wings divaricate, folded on the posterior margin.

Sp. *Ptych. contaminata, Tipula contaminata* L., Cuv. *R. Ani. éd. ill., Ins.* Pl. 162, fig. 4.

*Chironomus* Meig. (with addition of some genera), Fabr. Antennæ plumose. Ocelli none.

*Ceratopogon* Meig. Antennæ with thirteen joints in both sexes, pilose; the eight inferior joints in the male barbate outwards. Wings parallel, incumbent.

The larvæ live under the moist bark of dead trees. The head excepted, every ring has on the upper part two very long hairs, with a round knob at the extremity, not transparent, which looks like a pearl.

See Guérin *Ann. de la Soc. Entom. de France,* ii. pp. 161—167, Pl. viii.

*Corethra* MEIG. Antennæ with fourteen joints in both sexes, with hairs verticillate, very long in male. Wings incumbent.

Sp. *Corethra plumicornis* MEIG., *Corethra lateralis* LATR., PANZER *Deutschl. Ins.*, Heft 109, No. 16; CUVIER *R. Ani. éd. ill., Ins.* Pl. 161, fig. 4; the larva lives in fresh water, has forward on the head two curved hooklets, and is very voracious; RÉAUMUR *Ins.* v. Pl. 6, f. 4—15; SLABBER *Natuurk. Verlustig.* Tab. III. IV.; LYONET, *Ouvrage post.* Pl. 17, figs. 14, 15, 19.

*Chironomus* MEIG., *Tanypus* ejusd. Wings deflected. Anterior feet remote from the rest, inserted almost beneath the head, very long (at rest porrect). Antennæ filiform, with thirteen or fourteen joints in both sexes or in males alone, in females sexarticulate (*Chironomus* MEIG.)

Sp. *Chironomus plumosus, Tipula plumosa* L., CUV. *R. Ani. éd. ill., Ins.* Pl. 161, fig. 5. The larva is a blood-red worm, often met with in rain reservoirs; see RÉAUMUR *Ins.* v. Pl. 5, figs. 1—5. On the head are two black eye-spots, and two short antennæ consisting of one joint and two threads at the point (these are wanting in RÉAUMUR'S figure). The head is alternately drawn into and pushed out of the next following joint by the larva. The eggs of *Chironomus,* oval or navicular and united in strings, were formerly taken for plants (*Diatomaceæ*): *Gloinema* AGARDH and *Echinella;* see the observations of BERKELEY *Ann. of Nat. Hist.* VII. 1841, pp. 449—451. Pl. XIII. figs. 1—8; comp. KOELLIKER *Observ. de prima Insect. genesi,* 1842.

B. Proboscis porrect, of the length of thorax, or longer than thorax, made up of seven setæ. Palps quinquearticulate, porrect.

*Culex* L. Antennæ porrect, in male plumose, in female pilose. Wings squamate, incumbent.

*Ædes* HOFFMANNSEGG. Palps in both sexes very short.

Sp. *Ædes cinereus* HOFFMANN., CUV. *R. Ani. éd. ill., Ins.* Pl. 161, fig. 3.

*Culex* MEIG. Palps of male longer than proboscis, of female short, with first two joints very short.

Sp. *Culex pipiens* L., SCHELLENBERG Tab. 41, CUV. *R. Ani. éd. ill., Ins.* Pl. 161, fig. 1; everywhere very common, especially in the neighbourhood of turf-diggings, as in the province of Holland. The hum or song adds to the inconvenience. The females alone sting; the males, known by their plumed antennæ, little or not at all. Another species, with black-spotted wings and white-ringed feet, *Culex annulatus* FABR., has been often met with by me here in Leyden in winter and in the first days of spring, in mild weather, in dwellings.

The gnat (*Cousin, Schnacke, Mücke*) is commonly known. The larvæ live in water, and hang on the surface to breathe, with head downwards.

On the back, at the ninth ring of the abdomen, there is a tube for respiration. These larvæ swim expeditiously, change their skin a few times, and become pupæ, which also move sinuously, but do not eat, and advance in the water head upwards, it being kept in this position by two little tubes or horns that stand above the thorax and serve for respiration. On the last metamorphosis the skin splits between the tubes, and the perfect insect creeps into view through the opening thus effected. It drifts for a time upon the cast-off skin as on a little boat, until the wings are strong enough, when the gnat leaves the water. These metamorphoses occur within a period of three or four weeks. See SWAMMERDAM *Bijb. d. Natuur.* pp. 348—362. Tab. XXXI. XXXII.; RÉAUMUR *Ins.* IV. Tab. 43, 44; J. M. BARTHII, *De Culice Dissertatio*, Ratisbonnæ, 1737, 4to, c. Tab. &c.

*Anopheles* MEIG. Palps in both sexes of the length of proboscis.

Sp. *Anopheles bifurcatus, Culex bifurcatus L.*, GUÉR. *Iconogr. Ins.* Pl. 92, fig. 2.

Comp. on genus *Culex* ROBINEAU-DESVOIDY, *Essai sur la Tribu des Culicides, Mém. de la Soc. d'Hist. nat. de Paris*, III. 1827. pp. 390—413 (new genera *Sabathes, Psorophora, Megarhinus*).

## ORDER VII. *Hymenoptera.*

Hexapod Insects, with four membraneous wings, the inferior less and with fewer veins. Maxillæ elongate, mostly slender, encasing the labium. Abdomen of females almost always terminated by a *terebra* or *aculeus* (borer, sting). Metamorphosis complete.

*Hymenoptera* L., *Piezata* FABR. Amongst other works the following treat of this order:

J. L. CHRIST, *Naturgeschichte, Klassification und Nomenclatur der Insekten vom Bienen, Wespen und Ameisengeschlecht. Mit 60 ausgemalten Kupfert.* Frankf. a Main, 1791, 4to.

J. C. FABRICII, *Systema Piezatorum.* Brunsvigæ, 1804, 8vo.

G. W. F. PANZER, *Entomologischer Versuch die Jurineschen Gattungen der Hymenoptern nach dem Fabriziusschen system zu prüfen.* Nürnberg, 1806, 8vo. (also under the title of *Kritische Revision der Insektenfauna Deutschlands IIes Bändchen.*)

(The work of JURINE, *Nouvelle Méthode de classer les Hyménoptères et les Diptères*, av. fig. Tom. I. Genève, 1807, I have not been able to meet with).

C. DAHLBOM, *Clavis novi Hymenopterorum systematis adjecta synopsi Larvarum Scandinav. cruciformium. Cum Tab. lithog. color.* Lundæ, 1835, 4to.

Ejusd. *Synopsis Hymenopterologiæ Scandinaviæ.* Lund., 1840, 4to. (Of this the first part alone, which treats of the genus *Crabo*, is known to me).

A. LEPELETIER DE SAINT-FARGEAU, *Histoire Naturelle des Insectes Hyménoptères.* Paris, 1836—1846, 8vo, av. Pl., IV. Vol. (the last part by BRULLÉ).

This order is distinguished by four naked, membranous wings. GEOFFROY united the *Neuroptera* with it; LINNÆUS, however, had already (in the sixth edition of the *Systema Naturæ*, 1748) distinguished this order; and to the present day it has been preserved in systematic arrangements. The *Neuroptera* have usually retiform wings, with numerous small cells; in the *Hymenoptera* they are merely veined, and the under wings are commonly smaller than the upper. The lower jaws are mostly elongated, and form with the under lip a kind of proboscis by which fluids are conducted to the œsophagus. The under jaws serve not for manducation, but for the gnawing off matters with which these insects construct their nests, for the bearing of burdens, &c. There are three simple eyes present; the compound eyes are large, especially in the bees. The foot (*tarsus*) has constantly five joints. The abdomen of the female is almost always armed at the extremity with a sting, or with a borer for laying eggs. Already had it been justly remarked by ARISTOTLE[1], that the two-winged insects are distinguished by a sting in front, and the four-winged by a sting behind; the first wound in order to feed, the last to defend or to avenge themselves.

In some species there are wingless individuals, of which more hereafter. The hind wings have at the anterior margin, nearly in the middle, a row of stiff hairs or hooklets (*hamuli*), placed at equal distances, and only visible when magnified, by which they are fixed fast to the posterior or inner margin of the fore wings, and in flying lie in the same plane with these. It is especially in this order that in the determination of the genera use may be made of the veins and cells of the wings. JURINE has for this purpose devised a terminology, of which we must give a short account. His names have all a reference to the fore wing. The first vein of the upper wing, that next to the anterior or outer margin, he names *radius*, the second, that lies more inwards, *cubitus*. These two terminate

[1] Τετράπτερα... ὀπισθόκεντρά ἐστι· δίπτερα δὲ... ἐμπροσθόκεντρα. ARIST. *Hist. Anim.* L. I. cap. 5, med.

in a thickened point (*punctum alæ s. carpus*) in the middle of the outer margin of the wing. (It is, as may be readily supposed, without any intention of indicating an analogy with the bones of the fore-arm in vertebrate animals, that these names of *radius*, *cubitus* and *carpus* have been selected.) The following veins, or nervures, which like the *radius* and *cubitus* arise from the base of the wing, he names *nervi brachiales*. These veins form by their branching and mutual communication certain cells on the wing (*cellulæ s. areolæ*). The outermost vein, which runs from the *punctum alæ* to the apex of the wing, is named *nervus radialis*, because it seems to be a continuation of the *radius;* between it and the outer margin lies the radial cell (*cellula radialis*). From the *cubitus* there arises the *nervus cubitalis*, continued in like manner from the *punctum alæ;* the space which lies between this vein and the radial vein is named that of the cubital cells (*cellulæ cubitales*). Finally, there arise from the brachial veins *nervi recurrentes*, or such as form communications with each other or with the *cubitus*, and thus form other cells, the humeral cells (*cellulæ humerales*[1]).

These insects undergo a perfect metamorphosis. The larvæ of most species are worms without feet; in some species, however, the larvæ have six horny feet; still other larvæ have membranous feet; the larger number of these feet (from 12 to 16) distinguishes them from the caterpillars or larvæ of butterflies, which in other respects they resemble. The food of the larvæ is various; the perfect insect feeds especially on the juices of plants, or swallows the honey of flowers. Many species also attack other insects, and thus appear to live on prey; this prey, however, does not serve for their own nutriment, but for that of the larvæ; they are the females that bear it to their nest. The *hymenoptera* on the whole do not live longer than a year, from the egg to the last change. Many, as the *ants*, *wasps* and *bees*, live socially together in large bodies, and form a regulated society.

The intestinal canal of the *hymenoptera* begins with an œsophagus, narrow and ordinarily long, which runs straight through the thorax. In the abdominal cavity the œsophagus usually forms an oval expansion; only in some (*Crabro*, *Larra*, *Trypoxylon*) does this expansion form a lateral crop. The muscular stomach is little

[1] Compare the article *Aile des Insectes*, by AUDOUIN in *Dictionn. classique d'Hist. nat.*, Paris, 1822, 8vo. I. pp. 176—185, and *Encycl. méthodique, Hist. nat. Ins.* Tom. X. 1825, p. 264, or the article *Radiale*, by LEPELETIER DE SAINT-FARGEAU and SERVILLE.

developed, and has above four membranous valves; below it is narrowed in shape of a funnel, and usually is introduced into the next stomach by invagination. This stomach is cylindrical, of various length, and ordinarily divided by transverse folds as though into rings. The small intestine (beneath the insertion of numerous *vasa urinaria*) is narrower than the stomach, ordinarily not longer, sometimes even shorter than it; the rectum is wider again. The whole intestinal canal has no very considerable length; in many it is little longer than the body. In the larvæ of the wasps, according to RAMDOHR, there is nothing but a large blind stomach present; also in the pupæ of the bees there is no *anus;* but these have anterior to the stomach a narrow œsophagus, and behind the stomach an intestinal canal terminating blindly.

The air-tubes present in most hymenopterous insects sacciform expansions. In the bees and wasps even the lateral primary stems in the abdomen are widened into large air-sinuses. The nervous system exhibits different modifications in the different families. The first nervous ganglion, the *cephalic ganglion,* is usually large, since the optic nerves especially are much developed. The second ganglion under the œsophagus lies very close to the first. In the thorax there are ordinarily only two ganglia, of which, the posterior is large; in *Athalia centifoliæ* NEWPORT found three. The abdomen has from four to seven ganglia, ordinarily, however, only five or six.

This order does not contain any particularly large species, although in the mean they are somewhat larger than the *Diptera.* Only a few species are bright coloured; the colours most frequently occurring are brown, black and yellow. The species are uncommonly numerous, so that in this respect the order of *Hymenoptera* is perhaps inferior to the *Coleoptera* alone. Most of them indicate a very remarkable instinct, and many construct their nests artfully. There is one species from which man derives a great and immediate advantage, and which he has transported with himself to different regions of the globe. We mean the honey-bee, of whose history we shall shortly treat in the sequel.

In their metamorphosis these insects correspond with the beetles; in this respect they differ entirely from most of the *Neuroptera.* Some of them by their larvæ approximate to the butterflies; and some butterflies (*Sesia*) shew a great similarity with hymenopterous insects. However, beyond doubt, the *Hymenoptera* have the greatest affinity with the two-winged insects, and we believe that,

in a natural arrangement, they can take no other place than in the immediate neighbourhood of these. By inserting the *Lepidotera* between the two, as is done by LATREILLE, the natural transition is interrupted.

Section I. *Aculeata.* Abdomen always petiolate, in females (and neuters) armed with a puncturing sting that conducts, in many at least, a poison, or containing glands that secrete and ejaculate an acrid humour. Antennæ mostly with 12 joints (in *females*) or 13 (in *males*). Larvæ apodous.

*Sting-bearers.* The wings are constantly veined. The larvæ have a quantity of food sufficient for the entire state laid near the egg by the mother, or are provided with it daily by the sexless nurses. The latter is the case with those which live in society.

The sting here takes the place of the ovipositor of other insects; it is connected with an apparatus for the secretion of poison, which, in the bee, consists of two long blind tortuous tubes, which coalesce at an acute angle to form a single tube that expands into an oval bladder. From this bladder a fluid passes into the sting, just as from the excretory duct of the poison-gland of the viper into the hollow tooth. The sting consists of a pointed case grooved on the ventral surface, in which groove two fine *spiculæ* drawn to a point are placed. At the extremity these spiculæ are provided with sharp teeth, having their points or barbs reverted, which are less powerfully developed in the female (amongst bees in the queen) than in the sexless individuals (the working bees); also in the former the sting is longer and turned upwards, hollow on the ventral surface. Certain horny plates cover the base of the sting. In the males these parts are wanting. Comp. SWAMMERDAM *Bijbel d. Nat.* bl. 456—466, Tab. XVIII. figs. II—IV; RÉAUMUR *Ins.* V. pp. 340—369, Pl. 29; KUNZMANN in HUFELAND'S *Journal d. Praktischen Heilkunde,* 1820, s. 119—127. On the sexless individuals in the order of *Hymenoptera* we have treated above, p. 271.

Family XIV. *Mellifera* s. *Anthophila.* All the individuals winged. Wings expanded. First or basilar joint of posterior tarsi (*planta* KIRBY) large, compressed, elongato-quadrate or triangular. Maxillæ elongate, membranous, forming with the labium the proboscis.

The larvæ live on the pollen and honey of flowers. Most of the species unite for a time, or for the duration of their life, to form a large community. When the society is for life, there are constantly

many sexless individuals whose business it is to construct the nest, and to feed the larvæ uninterruptedly[1].

Phalanx I. *Apiariæ.* Median division of ligula filiform or setaceous, of the same length as mentum, or longer than mentum, inflected downwards, with the maxillæ, quite from the insertion of the maxillary palps. Two joints of labial palps mostly conjoined, forming a compressed horny seta or lateral lacinia of the ligula; two succeeding joints very small, set laterally upon the acuminate apex of former. Two short paraglossæ at the base of ligula.

The proboscis of the bee has been investigated by SWAMMERDAM (*Bijb. d. Nat.* bl. 445—451), RÉAUMUR (*Ins.* v. 6*ième Mémoire*, pp. 304—326), G. R. TREVIRANUS (*Verm. Schriften von* G. R. *u.* L. C. TREVIRANUS. II. 1817; *Ueber die Saugwerkzeuge der Insecten*, s. 112—130), and other writers; and although by these researches we are able to learn its structure and its peculiarities even to minuteness, yet there still remain obscurities and conflicting opinions, especially relating to the function of the parts. The maxillæ form an external case (*demi-etuis exterieurs* RÉAUMUR); the labial palps may be regarded as a second case, if the ligula alone be considered to be the proper proboscis. Concerning this ligula, SWAMMERDAM and TREVIRANUS adopted the opinion that it is perforated at the extremity by a fine aperture, and imbibes honey by its internal cavity. According to TREVIRANUS a canal runs from the base of the proboscis to the œsophagus, though he could not trace the canal to it. In this case bees must have two mouths, which is contrary to all analogy. The proper mouth lies, as RÉAUMUR correctly observed (whilst SWAMMERDAM placed it in the supposed aperture of the proboscis), in the ordinary situation, behind the maxillæ, and above the ligula; it is covered above by a little valve attached to the labrum (*epipharynx* or *epiglossa* of SAVIGNY[2]). According to RÉAUMUR the bees lick honey with the proboscis, just as many mammals drink by licking with the tongue. It is probable however that honey is sucked up by the bee, and that the proboscis at the time, like the sucker of a pump, is moved up and down between the maxillæ. See DUGÈS *Physiologie comparée*, II. pp. 317, 318, and especially the

[1] We possess on this division a Monograph by the Nestor of modern Entomologists, KIRBY *Monographia Apum Angliæ*, Ipswich, 1802, 8vo. 2 vols.

[2] We have noticed this little valve above at p. 281. This part, already recognised by RÉAUMUR, and considered by him to be the tongue, was also named by TREVIRANUS in bees *Zunge* (tongue), in wasps *vordere Zunge* (anterior tongue).

*Bijdrage tot de kennis der mond-dulen van eenige Hymenoptera*, by our accurate and profound BRANTS, *Tijdschrift voor nat. Gesch.* VIII. 1841, bl. 71—126.

α. *Social. Males, females* and *neuters* or *workers.* Maxillary palps short, uniarticulate. Posterior tibiæ in neuters dilated outwardly towards the extremity. First joint of tarsi tomentose externally, or furnished with brushes.

1. Posterior tibiæ with spurs either none or obsolete.

*Apis* FABR., nob. (spec. from genus *apis* L.) Mandibles with dorsum smooth.

Comp. LATREILLE, *Ann. du Mus.* IV. pp. 383—394, Pl. 69, V. pp. 161—171, Pl. 13; DE HUMBOLDT et BONPLAND, *Recueil d'Observations de Zoologie et d'Anat. comp.* I. 1811, 4to. pp. 270—297. Pl. 19—21; *Des Abeilles proprement dites, et plus particulièrement des insectes de la même famille qui sont propres à l'Amerique méridionale; par* LATREILLE).

*Melipona* ILLIG., LATR., *Trigona* JURINE. Cubital cells two. First joint of posterior tarsi obtrigonal.

Exotic species, almost all from South America, with mandibles denticulate (*Trigona* LATR.), or edentulous (*Melipona* LATR.) Comp. LATREILLE l.l.; M. SPINOLA, *Observations sur les Apiaires Meloponides, Ann. des Sc. nat.* 2e Série, Tom. XIII. 1840. *Zool.* pp. 116—140. Pl. 2; BLANCHARD, *Dict. Univ. d'Hist. natur.* VIII. 1847, pp. 85—89, art. *Meliponites.*

Sting none, or rather rudiments alone of sting, not adapted for puncturing.

*Apis* LATR. Cubital cells three. First joint of posterior tarsi elongato-quadrate, in neuters covered with hairs disposed in transverse rows, and produced anteriorly into an external tooth or auricula [1].

Sp. *Apis mellifica* L., *Honey-bee, Abeille domestique, Mouche à miel, Hausbiene, Honigbiene, Bee; Ann. du Mus.* V. Pl. 13, fig. 1—3; DUMÉRIL *Consid. gén. s. l. Ins.* Pl. 29, fig. 4; BRANDT u. RATZEBURG, *Mediz. Zool.* II. Tab. 24; blackish, yet apparently of a lighter colour from greyish hair, especially on the thorax; a transverse, woolly, gray stripe at the base of the third and following rings of the abdomen; length of the body about half an inch, breadth of outspread wings ten lines (in workers). This species is domesticated in Europe, and has been transported into America. All the species of the genus *Apis* LATR. belong originally to the Eastern hemisphere.

In one hive there are commonly 15,000 or 20,000 working bees, 600—800 males, named *drones* (the ancients named them κηφῆνες, *fuci*), and

[1] Comp. *Annal. du Mus.* IV. Pl. 69, fig. 5.

usually one female, the *queen*, (the *king* of the ancients). The working bees are smaller than the queen, which is also distinguished by a larger abdomen. The drones are as large as the queen, or larger, (the wings especially are larger); they have no sting, and the first joint of the tarsus of the posterior feet is neither invested with a woolly covering, nor lengthened into a point; the eyes are larger and close together.

The working bees are, as was first discovered by SCHIRACH, nothing else than imperfectly developed females. If the larvæ of workers in the first three days after leaving the egg receive a more abundant and more fluid nutriment, and be transferred to the larger royal cells, there proceed from these, according to observations, which have been often distrusted, but, as it seems, are not deceptive, fruitful females or queens. The instinct of the working bees is consequently the instinct of female animals; they accomplish a part of the maternal duties and take care of the larvæ, the progeny of their more highly preferred sister. Some of the working bees have the charge of collecting food and material for building; others, apparently weaker, remain in the hive, care for the feeding of the larvæ, and fulfil domestic duties.

These insects live originally in hollow stems of trees. Our domestic bees build in hives, to which different forms have been given. When a swarm of bees first comes into a hive, they cover it internally with an adhesive, resinous fluid, to keep out the cold air. This substance the ancients named *propolis;* the bees obtain it from the clammy buds and young leaves of willows, elms, &c. Next they build with the wax (which was formerly thought to be prepared from the pollen of flowers, but is a true secretion from the honey[1]) perpendicular flat cakes or combs, beginning from above. These cakes consist of hexagonal cells, placed horizontally on each side, and opposed to each other by their tops, which are formed of three rhombs that meet in a solid angle. Each of these cells has $5\frac{2}{3}$ millimeters in mean diameter, and, the royal cells excepted, the rest are nearly of the same size. Between the cakes they leave spaces, which serve as passages, and in which two bees can creep at the same time. Some cells contain eggs, others larvæ or pupæ, others again honey or pollen. The cell for the future queen is more spacious, almost cylindrical; its outer surface is rough, from impressed angular cavities, resembling imperfect cells. The number of these royal

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[1] As early as the middle of the last century (1774), a german priest (HORNBOSTEL), under the name of MELITTOPHILUS THROSEBASTUS, published observations on the separation of wax, which however were rescued from oblivion by TREVIRANUS only twenty years ago. The observations of JOHN HUNTER, *Phil. Trans.* 1792, p. 143, are better known. The secretion of wax occurs in very thin transparent little plates on the abdominal surface of the working bees, and is collected in the folds between the rings. See G. R. TREVIRANUS in FR. TIEDEMANN, G. R. and L. C. TREVIRANUS *Zeitschr. f. Physiol.* III. 1829, s. 62—71; comp. on the chemical question of the production of wax, a note in LIEBIG'S *Organ. Chem.* s. 307—315, from W. F. GUNDLACH'S *Naturgesch. der Bienen*, Cassel, 1842, and the observations of DUMAS and MILNE EDWARDS, supported by accurate weighing, communicated to the Academy of Sciences at Paris, *Ann. des Sc. nat.* 2e Série, XX. *Zool.* pp. 174—181.

cells is from two to twenty[1]. They usually hang like stalactites at the margin of the honey-combs. Much wax is bestowed on these cells, which sometimes weigh as much as 150 common cells.

Copulation, concerning which there has been much of fable, seems to occur during flight, and the lazy drones require to be excited to it by the queen. According to HUBER the penis remains in the queen, and the male dies in consequence; the rest of the males also, as well as the male larvæ, are put to death at the end of the summer, and cast forth from the hive.

The larvæ leave the egg after three days. After five days they prepare for changing. They surround themselves with a fine web, on which they are busied 1½ days, and three days afterwards change into pupæ. From the pupa after seven or eight days the perfect insect comes to view. This metamorphosis requires a shorter time in the queen, and a longer in the drones than we have here given for the workers (HUBER). The working bees, when the perfect insects make their appearance, purify the empty cells, that they may be ready for the reception of new eggs. If the queen, as occasionally happens, should lay more than one egg in a cell, they carry out the supernumerary one. In the first beginning of spring (from February to April) no other eggs are laid by the queen than those which are to produce working bees; the eggs of the drones are laid at a later period (April, May), and in succession; shortly afterwards follow queen-bee eggs. In this way the society increases, and then sends colonies forth. The old queen is at the head of the colony, and leaves a daughter behind in the kingdom which she is leaving. This is called *swarming*. Bees swarm several times in the summer; sometimes three or four swarms proceed from one hive; but the last swarms are small and commonly perish. That a hive is about to swarm, may be known by a certain noise or song, and an unusual movement within it. The swarm leaves the hive on a favourable day, and gathers on the branch of a tree, on which the bees hang like a large bunch of grapes.

Respecting the age which bees attain, there is difference of opinion. It is probable, however, as the experiments of HUBER shew, that they do not form an exception to other insects in this respect, and that, however a beehive may last five, ten, or even thirty years, there is no cause for believing that the bees themselves reach such an age as ARISTOTLE supposed, according to whom they may be six or seven years old. The queen lives longer than the working bees[2].

Bees have many enemies, especially amongst birds and insects; we shall afterwards have occasion to mention some of them. They are also exposed to many diseases.

Amongst the numerous works on bees we must limit ourselves to noting some. The two chief authors on Natural History amongst the ancients,

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[1] Occasionally, even more numerous according to some observations (RÉAUMUR once saw 40), but if ten be met with in a hive it must be considered to be a great number.

[2] F. G. DESBOROUGH, *On the durat. of Life in the Queen, Drone, and Worker of the Honey-bee. Trans. of the Entomolog. Soc. of London.* New Series, London, 1853, II. pp. 145—178.

ARISTOTLE and PLINY, must be used with caution, (ARIST. *Hist. Anim.* v. 21, 22; PLINII *Hist. Nat.* Lib. XI. cap. V—XX).

Amongst the moderns our SWAMMERDAM made many observations on bees, and bestowed especially much care on their anatomy, *Bijbel der Natuur. bl.* 369—550. The chief sources for knowledge of the economy of bees are: RÉAUMUR, *Mém. pour serv. à l'Hist. nat. des Ins.* V. pp. 207—728; M. A. G. SCHIRACH, *Hist. nat. de la Reine des Abeilles*, la Haye, 1771, 8vo; HUBER, *Nouvelles Observations sur les Abeilles*, 2 vols. 8vo. Paris et Genève, 1814.

A review of the collected observations of different writers was given first by CH. BONNET, *Contempl. d. l. Nat. onzième partie*, chap. 26, 27, *Œuvres*, Tom. IX. (éd. 8vo. Neuchatel, 1781), pp. 111—145, and afterwards by KIRBY and SPENCE, *Introd. to Entomol.* II. pp. 119—214, *Letters* 19, 20. Several works are quoted and used with deep erudition in the extensive article on the honey-bee, contained in the excellent work of BRANDT und RATZEBURG, *Medizin. Zoologie*, II. s. 177—205.

2. Posterior tibiæ armed with two spines at the inferior and inner part. (Cubital cells three.)

*Euglossa* LATR. Body smooth, shining. Proboscis elongate. Labrum quadrate.

*Aglaë* LEPELET.

Comp. *Encycl. méthod., Hist. Nat. Entomol.* Tom. X. 1825, p. 105. (These insects appear to be parasitic, and differ from *Euglossa* as genus *Psithyrus* does from *Bombus;* see below.)

*Bombus* LATR. Body hirsute. Proboscis moderate. Labium transverse.

*Humming-bees.* These insects construct their nest with mosses under the ground. Sp. *Bombus terrestris, Apis terrestris*, L., RÉAUM. *Mém. s. l. Ins.* T. VI. Pl. III. fig. 1, PANZER, *Deutschl. Ins.* Heft 1. Tab. 16; black, with a yellow ring in front on the thorax and a yellow stripe at the base of the abdomen, of which the extremity is white. *Bombus lapidarius, Apis lapidaria* L., RÉAUM. *Ins.* T. VI. pl. 1. fig. 1—4, CHRIST, Tab. 7. fig. 1, black, the extremity of abdomen orange or reddish. The species of this genus are numerous. They live in small societies and in inartificial dwellings, which bear the same relation to the thickly inhabited artistic habitations of bees, that hamlets or villages do to large towns. Amongst the females two varieties are found, of which the smaller alone lays eggs that produce males; so also in *Apis mellifica* workers are seen, that stand half way between common workers and the queen, and which appear to proceed from larvæ of workers, into whose cells some of the queen's food has casually fallen.

Some species have no neuters, and do not live in society, but parasitically in the nest of other *Bombi*. They ought, therefore, according to the strict requirements of systematic division, to be arranged with the following. Here belongs *Apis campestris* PANZER, *Deutschl. Ins.* Heft 74, Tab. 11. They form the genus:

*Psithyrus* Lepel. de St. Farg., *Apathus* Newmann.

Comp. Chr. Drewsen *og* J. Schiödte, *Fortegnelse over Danske Arter of Slægterne Bombus og Psithyrus;* Kröjer's *Tidsskr.* II. 2. 1838, pp. 105—126. Tab. II.

*β. Solitariæ.* Males and females alone, without neuters. Posterior feet with tibiæ not excavated outwards, with first joint of posterior tarsi not tomentose internally.

1. First joint of posterior tarsi produced at the external angle of the apex or slightly prominent: second joint placed in the opposite or internal angle. Posterior feet often large, very hirsute.

† Paraglossæ shorter than labial palps. (Cubital cells three.)

*Epicharis* Klug, Latr. Maxillary palps very short, with single joint.

*Acanthopus* Klug.

*Centris* Fabr. (in part). Maxillary palps with four joints.

Species exotic, American. Fig. Guérin, *Iconogr. Ins.* Pl. 74, fig. 6. Comp. on this genus Lepeletier, *Encycl. méthod., Hist. Nat. Ins.* Tom. x. p. 705.

*Ancyloscelis* Latr. (*Tetrapedia* Klug), *Ptilotopus* Klug.

*Saropoda* Latr. Maxillary palps with five joints.

*Anthophora* Latr. Maxillary palps with six joints.

Sp. *Anthophora hirsuta* Latr., *Apis plumipes* Pall., Pallas, *Spic. Zool.* IX. Tab. I. fig. 14;—*Anthophora parietina* Latr., *Annal. du Mus.* III. 1804, pp. 251—259. Tab. XXII. fig. 1, A—D.

*Melliturga* Latr.

†† Paraglossæ setaceous, of the length of labial palps or longer than these. (Cubital cells in some two, in others three.)

*Eucera* Scopoli, Fabr., Latr. (and *Macrocera* Spinola).

Comp. J. A. Scopoli *Annus quartus historico-naturalis.* Lipsiæ, 1770, 8vo. *Dissert. de Apibus,* pp. 8, 9.

Sp. *Eucera longicornis, Apis longicornis* L., Swammerdam *Bibl. nat.* Tab. XXVI. fig. 6; Panzer, *Deutschl. Ins.,* Heft 64. Tab. 21. The antennæ in the male are somewhat longer than the body.

*Melissodes* Latr.

2. First joint of posterior tarsi nearly of the same breadth or narrowed gradually from base to apex, with external angle little

or not at all produced; second joint inserted into the middle of apex of former.

† Labial palps different in form from maxillary, with two large basal joints compressed, dilated.

*Nomada* SCOPOLI, FABR. Mandibles small, narrow, unidentate or edentulous. Cubital cells in some three, in others two.

Sub-genera: *Oxea* KLUG, *Crocisa* JURINE, LATR., *Melecta* LATR., *Pasites* JURINE, *Epeolus* LATR., *Phileremus* LATR., *Ammobates* LATR.

Sp. *Nomada succincta* PANZ., *Deutschl. Ins.*, Heft 55, Tab. 21; *Nomada Roberjeotiana* PANZER, *ibid.* Heft 72, Tab. 19, &c.

Comp. HERRICH SCHÆFFER, *Auseinandersetzung der europäischen Arten einiger Bienengattungen*, in GERMAR'S *Zeitschr. f. die Entomol.* I. 2. 1839, s. 267—288; the same in his continuation of PANZER'S *Deutschl. Ins.* Heft 166 and 176.

*Megachile* LATR. (*Anthophora* FABR., *Phyllotoma* DUMÉR.) Labrum elongate, inflected, porrect below under the mandibles. Mandibles broad, dentate or narrow, porrect, bidentate at apex. Cubital cells mostly two.

1. *With two cubital cells.*

*a) With abdomen smooth or only downy, not pollinigerous.*

Sub-genera: *Cœlioxys* LATR., *Stelis* PANZER, LATR.

*b) With abdomen in females provided beneath with long setæ forming brushes for collecting pollen.*

* *With abdomen oval or triangular.*

*Anthidium* FABR., LATR. Maxillary palps with single joint.

Comp. LATREILLE, *Mémoire sur le genre d'Anthidie: Annales du Muséum*, XIII. 1809, pp. 29—53: pp. 207—234, Pl. 1.

Sub-genera: *Osmia* PANZER (*Trachusa* JURINE, in part, *Osmia* and *Anthocopa* LEPELET.), *Lithurgus* LATR., *Megachile* LATR. (*Chalicodoma* LEPELET.) Maxilliary palps with two to four joints.

Sp. *Megachile centuncularis*, *Apis centuncularis* L., DUMÉR. *Cons. gén. s. l. Ins.* Pl. 29, fig. 3, GUÉRIN *Iconogr. Ins.* Pl. 73, fig. 7. These bees cut pieces off rose-leaves, which they stick together and form into cases rolled artfully together in form of thimbles. They arrange several of these cases behind one another in a row, and lay in each of them an egg and a supply of food for the larva. See RÉAUMUR, *Ins.* VI. *Mém.* IV.—*Megachile muraria*, *Xylocopa muraria* FABR., RÉAUM. *ib. Mém.* III. Pl. 7, 8; G. C. SCHÆFFER, *die Maurerbiene*, 1764.

* * *With abdomen elongate, cylindrical.*

Sub-genera : *Heriades* SPINOLA, LATR., *Chelostoma* LATR.

2. *With three cubital cells.*

*Ceratina* LATR. Maxilliary palps with six joints.

Sp. *Ceratina albilabris, Prosopis albilabris* FABR., GERMAR and AHRENS, *Faun. Ins. Europ. Fasc.* v. Tab. 17, CUV. *R. Ani. éd. ill., Ins.* Pl. 126, fig. 5; in the south of Europe: on the economy of this insect comp. the observations of SPINOLA, *Ann. du Mus.* x. 1807, pp. 236—248.

†† Labial palps similar to maxillary.

*a*) Cubital cells three.

*Xylocopa* LATR. Labrum very hard, horny, transverse, with anterior margin ciliate. Mandibles sulcate, with point bidentate. Abdomen depressed, broad, with sides hirsute. Feet very hirsute.

Sp. *Xylocopa violacea, Apis violacea* L., DUMÉR. *Cons. gén. s. l. Ins.* Pl. 29, fig. 1; CUV. *R. Ani. éd. ill., Ins.* Pl. 126, fig. 4, in southern Europe, &c. Many large native species of remarkable size, with black or violet glistering wings, belong to this division, as also *Xylocopa morio* from Java, &c.

Sub-genus : *Mesotrichia* WESTW.

*Systropha* ILLIG. Antennæ of males convoluted into a spire at the apex.

*b*) Cubital cells two.

*Panurgus* PANZ., LATR., *Eriops* KLUG. Antennæ clavate or subclavate.

*Camptopœum* SPINOLA.

*Rophites* SPINOLA, LATR.

Phalanx II. *Andrenetæ.* Median portion of ligula shorter than mentum, lanceolate or cordate. Labial palps similar to maxillary, quadriarticulate. (Genus *Melitta* KIRBY.)

These bees are all solitary, and consist of male and female individuals alone. The females collect pollen, not only with the hind feet but with other haired parts of their body; they dig under ground and place by their egg a provision of pollen and honey. Others, not formed for gathering pollen, lay their eggs in the nests of other bees.

*Andrena* FABR. Median division of ligula acuminate at the apex, lanceolate or hastate (triangular, auriculate on each side).

Sub-genera: *Nomia Halictus, Sphecodes, Dasypoda, Andrena* LATR.

*Hylæus* LATR. (not FABR.), *Prosopis* FABR., JURINE, LEPELET. Ligula dilated at apex, sub-emarginate. Cubital cells two. Body smooth.

Sp. *Hylæus annulatus, Apis annulata* L., *Sphex signatâ* PANZER *Deutschl. Ins.* Heft 53, Tab. 2; CUV. *R. ani. éd. ill., Ins.* Pl. 125, fig. 1 &c.

*Colletes* LATR. Ligula emarginate, with lobes divaricate (cordate). Cubital cells three. Body hirsute.

Sp. *Colletes fodiens,* PANZER, *Deutschl. Ins.* Heft 105, Tab. 21, 22, &c.[1]

Family XV. *Diplopteryga.* All the individuals winged. Anterior wings longitudinally duplicate, the insect being at rest. First joint of posterior tarsi not dilated. Eyes emarginate (reniform). Antennæ filiform or thicker towards the apex. Prothorax produced laterally as far as the the origin of the posterior wings. Body smooth. Females and neuters armed with a strong poisonous sting.

*Wasps.* The inner edge of the upper wings is turned down so that their upper surface lies on the under wings[2]; hence the name *Diploptera* (*double-winged*), which KIRBY, because the termination *ptera* denotes the names of orders of insects, changed into *Diplopteryga* (J. RICHARDSON, *Fauna Boreali-Americana,* IV. 1837, p. 263).

The wasps are mostly coloured yellow or red and black. The pupæ are vermiform, and without feet. They are inclosed in separate cells, where they find food placed by the mother with the egg she has laid, or are fed daily by the mother or by the sterile working-wasps.

Phalanx I. Antennæ with only eight distinct joints, the rest conjoined to form an obtuse or rounded club. Ligula with two terminal laciniæ, received in the tubular base. Cubital cells only two complete.

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[1] Comp. *Entomologica, auctore* J. IMHOFF, OKEN'S *Isis,* 1832. s. 1198—1208; descriptions of species of the genera *Colletes, Hylæus* and *Andrena,* with remarks on the synonymy.

[2] The genus *Ceramius* seems to be the only exception to this, which however is denied by LEPELETIER, *Hist. nat. des Hyménoptères,* II. p. 590.

*Masaris* FABR.

*Masaris* LATR. Antennæ (of males) longer than head. Abdomen elongate.

*Celonites* LATR. Antennæ in both sexes very short, terminated by a globose club. Abdomen scarcely longer than thorax.

Sp. *Celonites apiformis*, PANZER, *Deutschl. Ins.* Heft 76, Tab. 19; DUMÉRIL, *Cons. gen. s. l. Ins.* Pl. 31, fig. 9; CUV. *R. ani. éd. ill., Ins.* Pl. 123, fig. 9; in southern Europe.

Phalanx II. Antennæ with all the joints distinct, 13 in males, 12 in females, with second joint geniculate, thicker from third joint towards apex, acuminate at apex.

a) *Solitary*[1]. Mandibiles elongated-triangular, connivent, like a rostellum. Ligula narrow, elongate. Clypeus sub-cordiform or oval, with anterior margin produced and truncated.

† Cubital cells only two.

*Ceramius* LATR., KLUG. Labial palps longer than maxillary.

Sp. *Ceramius Fonscolombii* LATR., GUÉRIN, *Iconogr. Ins.* Pl. 72, fig. 2.

†† Cubital cells three.

*Synagris* LATR., FABR. Ligula produced into four very long sub-plumose setæ. Maxillary palps short, with four joints. Mandibles of males very large, porrect.

Sp. *Synagris calida*, *Vespa calida* L., GUÉRIN, *Iconogr. Ins.* Pl. 72, fig. 3;—*Synagr. cornuta*, *Vespa cornuta* L., *Encycl. méth., Ins.* Pl. 382, fig. 10. Comp. on this genus LEPELETIER in *Encycl. méth. Ins.* Tom. X. pp. 509, 510.

*Eumenes* LATR., FABR. Ligula tripartite, with middle part deeply incised, bifid. Four glandular points at the apices of ligula. Maxillary palps with six joints.

a) *With abdomen oval or conical, thicker at the base.*

Sub-genera: *Pterochilus* KLUG (with labial palps plumose), *Odynerus* LATR. (*Rhynchium* SPINOLA).

Sp. *Odynerus auctus*, *Vespa aucta* FABR., PANZER, *Deutschl. Ins.*, Heft 81, Tab. 17; *Odyn. spinipis*, (fem. *Od. murarius*), PANZER, *Deutschl. Ins.* Heft 17, Tab. 18. (Here belong, according to AUDOUIN, the observations of RÉAUMUR, *Ins.* VI. pp. 251—268. Pl. XXVI. figs. 1—10.)

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[1] H. F. DE SAUSSURE, *Monographie des Guèpes solitaires*, av. 21 pl. color. Paris et Genève, 1852, 8vo.

Comp. on this genus WESTMAEL, *Monogr. des Odynères de la Belgique*, Bruxelles, 1833, 8vo, (*Ann. des Sc. nat.* XXX. 1833, pp. 426—432); HERRICH-SCHÆFFER, *Deutschl. Ins.* Heft 173, 176; LÉON-DUFOUR, *Mém. pour servir à l'Hist. de l'industrie et des métamorphoses des Odynères*, *Ann. des. Sc. nat.* 2e Série, Tom. XI. 1809. *Zool.* pp. 85—103. (*Odynerus rubicola*); AUDOUIN, *Observations sur les mœurs des Odynères*, *ib.* pp. 104—113.

b) *With first two joints of abdomen coarctated to form a petiole, the first narrow ob-conical, the second sub-campanulate.*

Sub-genus: *Eumenes* LATR. (*Zethus* FABR., *Discœlius* LATR.)

Sp. *Eumenes coarctata*, *Vespa coronata* PANZ., GEOFFR. *Ins.* II. Pl. XVI. fig. 2; PANZER, *Deutschl. Ins.*, Heft 64, Tab. 126, and *Vespa coarctata* PANZ. *ibid.* 63, Tab. 6; *Vespa pomiformis*, PANZ. *ib.* 63, Tab. 7, fem. &c.

b) *Social.* Mandibles subquadrate, obliquely truncated and denticulate at apex. Lingula little elongate, tripartite, with middle part bifid. Four glandular points at apices of lingula. Labial palps quadriarticulate, maxillary sexarticulate. Cubital cells three.

*Vespa* (Species from genus *Vespa* L., *Vespa*, *Polistes* LATR.)

In wasps the upper lip (*labrum*) is hidden behind the head-shield (*clypeus*) and upper jaws (*hintere Zunge*, TREVIRANUS, *Verm. Schr.* II. Tab. XV. figs. 7, 8, 9, L'). Close under the upper-lip is found a valve, which SAVIGNY names *epipharynx* or *epiglossa* (*vordere Zunge* TREVIRANUS). The *hypopharynx* of SAVIGNY (*Klappe* TREVIRANUS, l. l. s. 134, Tab. XV. figs. 6—8, letter V.) is a valve closing a cavity which was discovered by BRANTS, and named *gluten-cavity* (see his work cited above, p. 452, *Tijdschr. voor. Nat. Gesch.* VIII. bl. 97); in this cavity, not unlike the buccal sacs of certain mammals, the wasps keep small pieces of wood for building their nests[1]. The wasp's nest consists of a kind of paper, prepared from small pieces of old wood and bark of trees; they gnaw off the pieces with their upper jaws; the cakes are usually horizontal; the uppermost are formed first and afterwards the lower; they hang together by little pedicles, and the uppermost of all is fixed to the common covering; for most wasps form a common covering for their nests, whilst bees merely hide their waxen dwellings in hollow trees or under the ground. A wasp's nest either hangs freely in the air, or is formed under ground or in cavities of trees. The cells are hexangular, perpendicular, and generally with the opening facing downwards.

[1] On the *under-lip* (*ligula*) and the other parts of the mouth in wasps, comp. the fig. in RÉAUMUR, *Mém. s. l. Ins.* VI. Pl. 16, fig. 2.

In bees we saw a monarchy with a queen at the head; here the form of government is a republic, the members of which are supported less by their own industry than by rapine. Wasps are freebooters; they are very eager for the juice of fruits; they suck the fluid that adheres to meat in slaughter-houses, cut pieces off, rob bees of their honey and murder them, as well as other insects, not for their own use, but to feed their larvæ with them. This robber-state, however numerous its citizens may be, owes its origin to a single mother. She is fertilised in the autumn, and lives over the winter, whilst the neuters and males die, and in the spring commences the work alone. After a while she is assisted by sexless wasps which are her first-born children. In autumn males and females are born. At that time some hundreds of the last are often found in a single nest, dwelling in uninterrupted peace, whilst amongst bees only two or three females are able to be of one mind together, for a short time. The working wasps are smaller than the rest; they all die from the cold of winter.

Comp. RÉAUMUR, *Mém. s. l. Ins.* VI. *Mém.* VI. VII; BONNET, *Contemplation de la Nature*, XI. partie, chaps. 23—25; *Œuvres d'Hist. Nat. et de Philos.* Tom. IX. 8vo, pp. 99—100; KIRBY and SPENCE, *Introd. to Entomol.* II. pp. 107—112.

*Polistes* LATR. Clypeus produced anteriorly into a sharp tooth. Abdomen in some adhering to the thorax by a long petiole.

Sp. *Vespa nidulans* FABR., *Epipone chartaria* LATR., *Hist. nat. des Crust. et des Ins.* XIII. Tab. 102, f. 6; GUÉRIN, *Iconogr. Ins.* Pl. 72, fig. 7. This South-American species makes very large nests, as though of pasteboard, hung to a branch of a tree, like long sacks with a conical lower end, with an opening in the middle. The cells are attached to different transverse partitions, which are perforated in the middle; this is the *Guêpe cartonnière* of RÉAUMUR, *Ins.* VI. *Mém.* VII. p. 224, &c. Pl. 20—24, &c. To this division also belongs the honey-gathering wasp of the Brazils, named *Lecheguana;* see LATREILLE, *Mém. du Muséum*, XI. pp. 313—320, and another species which A. WHITE names *Myropetra scutellaris*, whose nest differs from that of *Vespa nidulans* by the conical knobs with which it is beset externally. *Ann. of nat. Hist.* VII. 1841, pp. 315—322.

To the division *Polistes* belong some European wasps whose nest has no common covering, the cells lying bare. SWAMMERDAM, *Bijbel der Nat.* Tab. 26, fig. 15; ROESEL, *Ins.* II. *Bomb. et Vesp.* Tab. VII.

*Vespa* LATR. Clypeus truncated anteriorly, emarginate.

Sp. *Vespa crabro* L., RÉAUMUR, *Ins.* VI. Pl. XVIII.[1]—*Vespa vulgaris* L., RÉAUM. *ibid.* Pl. XIV. figs. 1—7, PANZER, *Deutschl. Ins.*, Heft 49, Tab. 19, &c.

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[1] That this insect, the largest and most voracious wasp of Europe, may be to some extent tamed, and then is not to be feared, appears from the observations of P. W. J. MUELLER; see his amusingly written paper in GERMAR und LINCKEN, *Magazin der Entomologie*, III. 1818, s. 56—68.

Family XVI. *Heterogyna.* Females (amongst the solitary) or neuters (amongst the social) apterous; males less than females. Wings not plicate, with cells often few, incomplete. First joint of posterior tarsi not dilated. Females and neuters in some furnished with a sting, in others with anal glands that secrete a peculiar acid. Ligula small, membranous, round, excavated or hooded. Antennæ geniculate.

Phalanx I. *Socialia* or *Formicariæ.* Males females and neuters, or abortive females. Neuters apterous, without ocelli, with head very large, and labium large, descending under the mandibles. Mandibles strong, often denticulate. Antennæ filiform or subincrassated towards the apex, with first joint very long, cylindrical or obconical. Petiole of abdomen formed of one or two globose nodes.

*Formica* L.

*Ants* (*fourmis, Ameisen, mieren*). The females have wings that easily fall off, or are stript off by themselves after copulation. The sexless individuals on the contrary are without wings, and without simple eyes (*ocelli*) also; they are, like the working bees, imperfect females, as appears also from the observation of HUBER, who frequently saw males copulate with them, but the act always caused the death of the neuters. The males and females are found as perfect insects in the nests for a short time only, for they desert them as soon as they have gotten their wings. The males are smaller than the females, and have also a smaller head and smaller upper jaws, but larger eyes. These animals live together socially, construct for themselves nests of earth, leaves, straw[1], &c., in which other insects and their larvæ often reside, as those of *Cetonia* and other *Coleoptera*, especially *Brachelytra*, which in these last times has given occasion to much inquiry among entomologists[2]. Above the place where they dwell the ants raise small hillocks or round heaps of earth. Other species live in hollow stems of trees. Along straight roads

[1] Hence there exists a species of vegetable manure and a high temperature in an ant's nest, which continues even after it has been deserted by its inhabitants. ROBERT, *Ann. des Sc. nat.* sec. Série, XVIII. *Zool.* 158.

[2] On insects living in ants' nests, see amongst others: MANNERHEIM, *Bullet. de la Soc. imp. de Moscou*, XVI. 1843, pp. 70—78, MÆKLIN, *ibid.* XIX. 1846, pp. 157—187, and especially FR. MAERKEL in GERMAR'S *Zeitschr. f. d. Entomol.* III. 1841, pp. 20—225, *ibid.* V. 1844, S. 193—271.

over the ground, often a hundred feet long, which all end like rays at the dwelling, the ants pass to and fro; irregular and tortuous passages lead to the separate habitation of the future generation. All the labour of building, of nursing and feeding the larvæ &c. is discharged by the neuters. They live on fruits, insects and their larvæ, on dead birds and small mammals. They are very fond of sugar, and follow the plant-lice in order to swallow the sweet sap (the honey-dew) that drops from their body. They lay up no provision for winter, as far at least as relates to our native species, but pass the winter in a state of torpor, taking no food at all in the severest cold. The working ants bear the larvæ and nymphs with the greatest care between their jaws to the surface when the sun shines on their dwelling, and down again when rain falls on the earth, and they defend with incredible courage the commonwealth which has no other government but a true republic. The larvæ and pupæ are commonly taken for eggs by the uninformed, and serve for food for certain singing birds in cages: nightingales especially are fond of them. In the last days of summer (August), in warm clear weather, the winged males and female leave the nest in which they have been brought up, fly in swarms through the air, copulate, and die soon afterwards, being swallowed by birds, or drowned in water and made food for fishes. The females that are left divest themselves with their feet of the wings that are now useless, and found a new colony; working ants, in whose neighbourhood they chance to be, drag them to their nest to lay their eggs there; when that is accomplished they are driven without mercy from the nest.

Comp. on Ants:

SWAMMERDAM, *Bijbel der nat.* bl. 287—299; CH. DE GEER, *Ins.* XVIIIième *Mém.* II. pp. 1042—1107; BONNET, *Contempl. de la Nature*, Partie XI. chap. 22, *Œuvr. compl.* 8vo, IX. pp. 89—98; KIRBY and SPENCE, *Introd. to Entom.* I. pp. 479—484; II. pp. 45—106; OKEN, *Allgem. Naturgesch.* Vol. 2, 1835, pp. 895—945.

LATREILLE, *Hist. nat. des Fourmis*, 1 Vol. 8vo, av. fig. Paris, 1802.

P. HUBER, *Recherches sur les mœurs des Fourmis indigènes*, 1 Vol. 8vo, av. fig. Paris et Genève, 1810.

LUND, *Sur les habitudes de quelques Fourmis du Bresil. Ann. des Sc. nat.* XXIII. 1831, pp. 113—138.

A. Petiole of abdomen composed of two distinct nodes. Females and neuters furnished with sting.

*Myrmica* LATR. (with addition of other genera).

Sub-genus: *Atta* FABR., LATR., Maxillary palps short, with five joints or fewer.

Sp. *Atta cephalotes* FABR., *Formica cephalotes* L., DE GEER, *Ins.* III. Pl. 31, fig. 11, LATR. *Fourmis*, Pl. IX. fig. 57, KOLLAR, *Brasil. vozügl. läst. Ins.* fig. 10. The neuters are five lines long with a very large head, heart-shaped, armed behind with two small spinules, chestnut-brown all over. These ants can strip whole trees of their leaves in a few hours. In Surinam and Brazil[1].

Add sub-genera: *Cryptocerus* LATR., *Stenamma* WESTW., *Myrmecina* CURTIS, *Myrmecaria* SAUNDERS, *Carebara* WESTW., *Solenopsis* WESTW., *Pheidole* WESTW.

Comp. J. O. WESTWOOD, *Descriptions of several exotic species of Ants, Ann. of nat. Hist.* VI. pp. 86—89.

Sub-genera *Myrmica* LATR. (and *Ecriton* ejusd.). Maxillary palps long, with six joints.

Sp. *Myrmica rubra, Formica rubra* L., FABR., SWAMMERDAM, *Bijbel d. nat.* Tab. XVI. figs. 1—13. LATREILLE, *Fourmis*, Pl. X. f. 62. Comp. on this ant, whose sting he has also figured, LEEUWENHOECK, 58e, *Missive von* 9 Sept. 1687, *Vervolg der Brieven*, bl. 97—107.

B. Petiole of abdomen with a single joint.

*Ponera* LATR. Females and neuters aculeate.

Add sub-genera: *Odontomachus* LATR. (*Daceton* PERTY does not differ from *Odontomachus*, on WESTWOOD'S authority), *Condylodon* LUND, *Typhlopone* WESTW., *Anomma* SHUCK.

Comp. SHUCKARD, *Ann. of Nat. Hist.* V. pp. 326—328; WESTWOOD, *ibid.* VI. pp. 81—85.

*Formica* LATR. (spec. from gen. *Formica* L.) Sting none.

Add sub-genus: *Polyergus* LATR.

Sp. *Formica rufa* L., LATR., *Fourmis*, Pl. V. fig. 28, AB, (fem. *Formica dorsata* PANZER, *Deutschl. Ins.* Heft 54, Tab. 1). This species, without a sting, affords the formic acid (*Acidum formicarum s. formicicum, acide formique*), a secretion from glands in the abdomen of the females and neuters. This acid is constantly fluid, colourless, of a pungent smell and sharp taste. FOURCROY and VAUQUELIN were of opinion that it consists of a mixture of acetic and malic acid; but the experiments of GEHLEN and others have shewn that it is a peculiar acid.

*Formica rufescens* LATR., *Fourmis*, p. 186, Pl. VII. fig. 38; this species robs the nests of other species of ants of the larvæ and pupæ of neuters, and carries them to its nest, where they are brought up with the young of their robber by neuters which have proceeded from larvæ and pupæ stolen

[1] Ants are very numerous in South-America, and, by removing dead animals and destroying other insects, perform the same office in the economy of nature with the *Carabici* and *Dermestes* and other *Clavicornes*. The natives also eat ants. Smoked ants (*Vachacos*) are a favourite article of food with the Indians at the *Rio-negro*; V. HUMBOLDT'S *Reise in die Æquinoctial-Gegenden*, IV. s. 315.

at an earlier period. These ant-nests are thus inhabited by two different species, of which one alone works. They are the *Amazon-ants* of HUBER, whose observations have been confirmed by LATREILLE (*Mémoires sur divers sujets*, Paris, 8vo, 1819, pp. 236—240), and by HANHART (*Wissenschaftlicher Zeitschr. von Lehrern der Baseler Hochschule*, cited by OKEN, *Allg. Naturgesh.* v. 2. s. 943—945).

Phalanx II. *Solitaria* s. *Mutillariæ*. Males and females alone. Males winged. Females apterous, without ocelli, furnished with sting. Antennæ filiform, with first and third joints elongate.

BURMEISTER and WESTWOOD place these insects in the neighbourhood of *Scolia* in the following division.

*Dorylus* FABR., LATR. Antennæ short, inserted near the mouth, above the forcipate mandibles. Head small. Abdomen elongate, cylindrical. Body, especially thorax, downy.

Insects of which the males alone are known, perhaps parasitic in ants' nests. Sp. *Dorylus helvolus, Mutilla helvola* L., DUMÉR. *Consid. gén. s. l. Ins.* Pl. 32, fig. 1 (below); CUV. *R. Ani. éd. ill., Ins.* Pl. 118, fig. 1 (the feet are here badly depicted); habit. Cape of Good Hope. All the species are exotic, from the eastern hemisphere, particularly Africa. (There is in the Leyden Museum a species from Java and from Siberia?)

(Add sub-genera: *Rhogmus* and *Ænictus* SHUCKARD).

*Labidus* JURINE, LATR.

All the species American. According to SHUCKARD, genus *Typhlopone* WESTW. should belong here and contain the females of the *Labidi*, on which point see the opinion of WESTWOOD, *Ann. of Nat. Hist.* VI.

But on *Dorylus* comp. by all means SHUCKARD, *Monograph of the Dorylidea, Annals of Nat. History*, v. 1840, pp. 188—201, pp. 258—272, pp. 315—396.

*Mutilla* L. (exclusive of *Mut. helvola.*) Antennæ inserted above the anterior margin of the clypeus. Head transverse, broad. Abdomen oval or conical. Feet of females strong, with tibiæ spinous ciliated.

A. *Mutilla* LATR. (spec. of *Mutilla* L.) Thorax undivided.

Sp. *Mutilla rufipes* FABR., *Mutilla sellata* PANZER, 6 or 7 millim. in size, thorax and feet red-brown, abdomen black with a white spot on the middle and a transverse band of white hairs at the posterior extremity. The male is *Mutilla ephippium* FABR., CUV. *R. Ani. éd. ill., Ins.* Pl. 118, fig. 3.

Add sub-genus: *Apterogyna* LATR., DALM. Antennæ long, in males almost of the length of body. Thorax undivided. Two anterior segments of abdomen narrower, discrete.

Sp. *Apterogyna Olivierii. Dictionn. class. d'Hist. nat.* Tab. 71, fig. 9, from Arabia and Egypt &c.

*Psammotherma* LATR. Antennæ (of males) bipectinate.

Sp. *Psammotherma flabellata*, CUV. *R. Ani. éd. ill., Ins.* Pl. 118, fig. 6.

B. Thorax (in females) divided or nodose. Sub-genera: *Methoca* LATR. (male *Tengyra* LATR.), *Myrmosa* LATR., *Myrmecoda* ejusd. (male *Thynnus, Scotœna*).

*Note.*—That *Tengyra* is the male of *Methoca* was observed by VAN DER LINDEN, *Ann. des Sc. natur.* XVI. 1829, pp. 48, 49; on the others, comp. WESTWOOD, *Introd. to Modern Classif.* II. p. 215.

Genus *Scleroderma* KLUG. Is this its place?

Family XVII. *Fossores* s. *Sphegina*. Wings in both sexes obvious, expanded. Tarsus of posterior feet simple. Aculeate, solitary hymenoptera, (*males* and *females* alone).

*Diggers.* This family consists principally of the genus *Sphex* (sand-wasp) of LINNÆUS. The females of most of the species dig in the ground nests for their young, and lay in these holes near their eggs insects or larvæ, sometimes spiders, as food for their larvæ when they leave the egg. The larvæ have no feet, resemble maggots, and spin themselves in, before changing into pupæ. The perfect insect is usually very lively, and sucks with avidity the honey-sap of flowers, on which (especially on the *Umbelliferæ*) it is frequently met with. In many the lower jaws and under-lip are prolonged and form a rostrum; the *ligula* however is not filiform, but commonly has a broad termination.

*Crabro* FABR. Prothorax very short, linear, transverse, remote from the origin of anterior wings. Feet short or of moderate length. Head large, quadrate above. Labrum concealed or scarcely exsert, transverse. Abdomen obovate, constricted or clavate at base, petiolate. Antennæ often thicker towards the apex.

Sub-genera: *Cerceris* LATR., *Philanthus* FABR., LATR., *Psen* LATR., JUR. (*Mimesa* SHUK.), *Alyson* JURINE, *Mellinus* FABR., *Pemphredon* LATR., *Stigmus* JURINE, *Crabro* FABR., *Gorytes* LATR., *Trypoxylon* LATR., FABR.

*Note.*—Genus *Crabro* (in the stricter sense) is distinguished by antennæ geniculate, mandibles bifid at apex, a single cubital cell alone complete, a radial cell appendiculate (another imperfect). LEPELETIER DE ST. FARGEAU divided it into several genera, of which for the sake of brevity I omit the names. See his *Hist. nat. d. Hymén.* III. pp. 99, &c., and a critical revision by HERRICH SCHÆFFER, *Deutschl. Ins.* Heft 179—181. Comp. also DAHLBOM, *Synops. Hymenopterol. Scandinav.* I.

These insects are mostly coloured black with yellow spots and stripes. The anterior part of the head (*clypeus*) is beset with fine smooth hairs that often have a beautiful silvery or golden lustre. They lay their eggs in holes, which they excavate with their fore-feet, and place near them a provision of food (insects or spiders—every species appears to select by preference a definite kind), which they drag either with their jaws or their hind feet. LEPELETIER DE ST. FARGEAU was of opinion that certain species whose fore-feet are not at all or only slightly haired, and hinder-feet without spines, are unfit for digging, and that they lay their eggs in the holes of other species, like the cuckoo in the class of birds. But later observations oppose this; see WESTWOOD, *Introd. to Mod. Classif.* II. pp. 188—190.

Sp. *Crabro cribrarius, Sphex cribraria* L., DUMÉR. *Cons. gén. s. l. Ins.* Pl. 31, fig. 3; PANZER, *Deutschl. Ins.* Heft 15, Tab. 18, 19; black; a yellow transverse streak forward on the thorax, as also a small double spot on the middle of the thorax between the posterior wings and different transverse stripes, of which the two middlemost are interrupted in the middle; the *tibiæ* and *tarsi* of the same colour; length 7 lines. The male of this, as of some other species, has on the tibiæ of the forefeet a disciform expansion, which on copulation serves to clasp the female. This disk has been taken for a sieve (from whence the specific name is borrowed), and the property of sifting the pollen of plants been recognised in the insect. (ROLANDER, *Ventensk. Akad. Handlingar*, Stockholm, 1751). This strange opinion owes its origin to the erroneous notion that the light transparent points seen on the disc are apertures; it was refuted by DE GEER (*Mém. s. les Ins.* II. p. 818) and GOEZE (*Natursforscher* II. 1774, s. 21—65).

*Nysson* LATR. Antennæ filiform. Abdomen conico-ovate or conical, broader at the base. Head moderate. The rest of the characters of the preceding genus. Mandibles entire.

Sub-genera: *Pison* SPINOLA, LATR., *Nitela* LATR., *Oxybelus* LATR., JURINE, *Nysson* LATR., JURINE, *Astarte* LATR. (*Dimorpha* JURINE.)

Sp. *Oxybelus uniglumis, Crabro uniglumis* PANZ., *Deutschl. Ins.* Heft 64, Tab. 44; GUÉRIN, *Iconogr. Ins.* Pl. 71, fig. 2, &c.

*Larra* FABR. Prothorax short, transverse, linear, not extended as far as the origin of anterior wings. Feet short or moderate. Labrum concealed. Mandibles at the base deeply emarginate on the outer side. Abdomen conical.

*Dinetus* JURINE, *Miscophus* JURINE, *Larra* FABR. (in part), LATR., *Lyrops* ILLIG., LATR. (*Liris* FABR.), *Palarus* LATR., *Dryudella* SPINOLA, *Gastrosericus* ejusd. (*Ann. de la Soc. entom. de France.*)

Sp. *Larra ichneumoniformis* FABR., PANZER, *Deutschl. Ins.* Heft 76, Tab. 18, &c.

*Bembex* FABR. Prothorax and feet as in the preceding genus. Labrum exsert, often triangular, inflected. Mandibles narrow, dentated on the internal side. Maxillæ and labium often extremely elongate, inflected. Body elongate, abdomen ovato-conical.

Sub-genus *Bembex* LATR., (and *Monedula* ejusd.) Labrum triangular. Maxillæ and labium very long, linear, inflected, forming the promuscis.

Sp. *Bembex rostrata, Apis rostrata* L., PANZER, *Deutschl. Ins.* Heft 1, Tab. 10; DUMÉR. *Cons. gén. s. l. Ins.* Pl. 30, fig. 10; LATR. *Ann. du Mus.* XIV. Pl. 26, figs. 9—13; black, felty, with yellow feet, and light greenish yellow transverse bands on the abdomen; 9—10 lines long. The female digs holes in the sand, and lays in each of them an egg with a sufficient quantity of Diptera (especially *Eristalis tenax*) for feeding the larva. Most of the remaining species are at home in warm regions; but the species quoted occurs occasionally all over Europe, even in Sweden.

Sub-genus *Stizus* LATR., JURINE. Labrum small, semicircular. Maxillæ and labium porrect, not inflected, nor elongato-linear. (Intermediate lacinia of labium elongato-cordate. Maxillary palps somewhat long, extended beyond the apex of maxilla.)

Sp. *Bembex ruficornis* FABR., *Ent. syst., Larra ruficornis ejusd. Syst. Piez.*, CUV. *R. Ani. éd. ill., Ins.* Pl. 121, fig. 3; habit. in south of Europe and Numidia, &c.

*Sphex* LIN. (exclusive of many species). Prothorax continued laterally as far as the anterior wings, narrowed forwards, resembling a joint or node. Labrum scarcely or not at all exsert. Three complete cubital cells. Antennæ slender, with joints elongate, often, at least in females, convolute or arcuate. Posterior feet very long, with tibiæ and tarsi spinose. Abdomen adhering to thorax by a long petiole.

* With mandibles edentulous.

Sub-genera: *Pelopoeus* LATR., FABR., *Podium* FABR., (*Trigonopsis* PERTY), *Podium* LATR. (not FABR.), *Ampulex* JUR., LATR. (*Chlorion* FABR. in part).

** With mandibles on inside dentate.

Sub-genera: *Dolichurus* LATR., *Trirogma* WESTW., *Aphlelotoma*

Westw.[1], *Chlorion* Latr. and Fabr. in part, *Sphex* Latr., *Pronæus* Latr., *Ammophila* Kirby[2].

Sp. *Sphex sabulosa* L. (*Ammophila*); Panzer, *Deutschl. Ins.* Heft 65, Tab. 12, &c.

*Pompilus* Fabr. Prothorax produced as far as anterior wings, subquadrate, not narrower forward. Abdomen with very short petiole. Posterior feet long, ciliated on the inner margin. Cubital cells three, or two, alone. Antennæ as in the preceding genus.

Sub-genera: *Aporus* Spinola, *Planiceps* Latr., *Pompilus* Latr., *Ceropales* Latr., Fabr., *Pepsis* Fabr. (in part), Latr.

On these and other sub-genera comp. Lepelet. *Hymenop.* III., and J. Schiödte *de speciebus Pompilidarum in Dania obviis*, Kröyer's *Tidsskr.* I. 1837, pp. 313—354. Tab. IV.

Sp. *Pompilus viaticus* Fabr., *Sphex fusca* L., Panzer, *Deutschl. Ins.* Heft 65, Tab. 16; Dumér. *Cons. gén. s. l. Ins.* Pl. 33, fig. 3, &c.

*Sapyga* Latr., *Hellus* Fabr. Prothorax transverse, produced to anterior wings. Abdomen elongate, shortly petiolate. Labrum not or scarcely exsert. Mandibles strong. Eyes emarginate (lunate). Antennæ of length of head and thorax at the least, towards the apex thicker or sub-clavate. Feet short, slender, with smooth tibiæ.

Sp. *Sapyga quinquepunctata* Latr., *Gener. Crust. et Ins.* Tab. XIII. fig. 9, (of which perhaps *Sapyga varia*, *Encycl. méth.* and Guérin, *Iconogr. Ins.* Pl. 69, fig. 11, is merely, as Lepeletier supposes, a variety), habit. in France.

*Note.*—Genus *Polochrum* Spinola, unknown to me, differs from *Sapyga* by its antennæ filiform.

Here also were referred formerly genera *Thynnus* Fabr. (in part), Latr., and *Scotæna* Latr. Partly at least they belong to the *Mutillaria*, and contain males of genus *Myrmecoda*. Comp. also genus *Amblysoma* Westw. and *Anodontyra* ejusd., Guérin, *Magas. de Zool.* 1841, *Ins.* Pl. 80, 81; females are unknown.

*Scolia* Fabr. Prothorax produced laterally as far as wings, as in the preceding genus. Eyes emarginate, reniform. Antennæ thick, filiform, in males almost of the length of head and thorax,

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[1] *Annals and Magazine of nat. Hist.* VII. 1841, p. 152.

[2] *Transact. of the Linn. Soc.* Vol. IV. 1798, p. 195. For some other *sub-genera* we may refer to Lepeletier, *Hymenopt.* III.

in females shorter, arcuate. Labrum retracted. Mandibles strong, cruciate. Abdomen elongate, with short petiole; body hirsute.

Sp. *Scolia quadrimaculata* F., DUMÉR. *Consid. gen. s. l. Ins.* Pl. 31, fig. 2, habit. in North America, &c. Most of the species exotic, some very large. In the South of Europe occur *Scolia hortorum* FABR., *Scolia insubrica* (*Scolia interrupta*) PANZER, *Deutschl. Ins.* Heft 62, Tab. 14, &c.

*Note.*—The males are distinguished by longer abdomen, trispinose at apex (anus tridentate), whence the name of the genus appears to be derived (σκῶλος, *spina*). Feet of females thicker, very hirsute.

Add sub-genera *Meria* ILLIG., LATR., *Myzine* LATR., *Tiphia* FABR.

Section II. *Terebrantia.* Abdomen in females furnished with a borer or ovipositor, sessile in many. Antennæ various, usually with joints more or fewer than thirteen. Upper capitulum of femur mostly distinct, as though forming a second trochanter.

Amongst these *Hymenoptera*, which deviate more from the usual type, there are many species whose larvæ are provided with six horny feet. HARTIG first drew attention to the difference of articulation between the hip and the thigh, and named these *hymenoptera*, on that account, *ditrocha*, and those of the former division, on the other hand, *monotrocha*. SUNDEVALL has given a better explanation of this disposition, which we have followed in our statement of characters; *Arsberättelse om nyare zoologiska Arbeten* 1837—1840. Stockholm, 1841, pp. 324, 325. The genus *Chrysis* according to this character ought to belong to the first division.

A. *Entomophaga* (*Pupivora* LATR.) Abdomen petiolate. Larvæ apodous, mostly living parasitically in other insects.

Family XVIII. *Chrysidides.* Inferior wings with no cells, but only some longitudinal veins; superior with radial cell long, single cubital cell imperfect. Antennæ filiform, with thirteen joints in both sexes. Abdomen joined to thorax by narrow, very short petiole, below plane or vaulted, composed of only three or of four conspicuous segments, dentate posteriorly in many. Integuments of body hard, smooth. Borer of females inclosed in concealed terminal segments of abdomen, receiving one another by invagination, composed of three setæ, the groove of one containing the two others.

The *golden-wasps*. These insects were thus named on account of the shining metallic colours in which they glitter (the abdomen is

mostly gold-green or purple-red, sometimes blue, just as the head and thorax usually are), and which have caused them to be compared with humming-birds.

The first joint of the antennæ is elongate; at the second joint they are bent geniculately. The females lay their eggs in the nests of other *hyménoptera*, whose larvæ are eaten by theirs. These insects are protected from the sting of bees and other *hymenoptera*, their natural enemies, by their hard integument; and besides this, they have the power of bending the abdomen under towards the thorax, and so, like the Armadillos amongst the mammalia, of contracting themselves into a ball. They form the transition between the first and second divisions, and are joined to the first, that of the *aculeata*, by HARTIG, because they are without the part which he considers to be a second trochanter.

Comp. on this family LEPELETIER, *Mém. sur quelques espèces nouv. d'insectes de la section des Hymenoptères porte-tuyaux*, av. fig. col., *Ann. du Mus.* VII. 1806, pp. 115—129.

The borer, improperly named a sting, is described and figured by DE GEER, *Mém. p. l'Hist. d. Ins.* II. pp. 834—836, Pl. 28, f. 19—21, Pl. 29, figs. 1, 2.

*Parnopes* LATR. Maxillæ and labium very long, linear, forming a kind of promuscis inflected beneath the thorax. Maxillary and labial palps very short, biarticulate.

Sp. *Parnopes carnea* LATR., DUMÉR. *Cons. gén. s. l. Ins.* Pl. 31, fig. 7; AHRENS (GERMAR) *Faun. Ins. Eur.* Fasc. II. Tab. 16. This species has its habitat in the south of Europe, and lays its eggs in the nest of *Bembex rostrata*; see LATREILLE, *Ann. du Mus. d'Hist. nat.* XIV. p. 415.

*Chrysis* L. Labium not in form of a promuscis. Maxillary palps with five joints, labial triarticulate.

*a*) Palps equal.

Sub-genus *Stilbum* SPINOLA, (*Stilbum* and *Euchrœus* LATR.)

*b*) Maxillary palps longer than labial.

Sub-genera: *Cleptes* LATR., *Chrysis* SPINOLA, *Elampus* SPINOLA, *Hedychrum* LATR.

Sp. *Chrysis ignita* L., FRISCH, *Ins.* IX. Tab. X. fig. 1, SULZER, *Die Kennz. der Ins.* Tab. XIX. fig. 121, CUV. *R. Ani. éd. ill., Ins.* Pl. 116, fig. 6, glittering, with thorax green, and abdomen golden from above of a fire-red play, and having at its extremity four denticles. *Chrysis cyanea* L., PANZER, *Deutschl. Ins.* Heft 51. Tab. 10, &c.

Family XIX. *Oxyura* s. *Proctotrupii* LATR. (*Codrini* DALMAN, NEES VON ESSENBECK, with addition of other genera.) Inferior wings without nervures, superior either in like manner without any nervures, or with few and longitudinal only, destitute of cubital cell and often of humeral likewise. Antennæ with 8—15 joints (in most 10—12), filiform or thicker towards extremity, in males mostly longer, in females sometimes clavate. Borer or ovipositor at the extremity of abdomen, in some exsert, conical, in others retractile within the abdomen, containing three setæ.

These *tail-boring ichneumons* are mostly very small, some only 1 or $\frac{3}{4}$ line in size, or even smaller (*Ichneumon atomus* L.), so that the investigation of the oral parts is rendered very difficult, and the characters derived from them are often insecure. The head in most of them is broad, the thorax long, the abdomen oval or conical. In some there are no wings, or very imperfect wings (especially in females); some have only four joints in the tarsus (*Iphitrachelus* HALIDAY, *Mymar*, &c.), which has also been observed in the family of the *Chalcidiæ*, a remarkable anomaly in the *Hymenoptera*. The economy of the greater part is unknown; but we may conclude, from those whose metamorphosis is known, that their larvæ live parasitically in other insects, like the true *Ichneumons*, with which LINNÆUS united the few species that were known to him. The larvæ of *Platygaster* live as parasites in those of the genus *Cecidomyia* (*Diptera*). Other species lay their eggs in the eggs of other insects (especially of *Lepidoptera* and some *Hemiptera*). To these belongs the *Ichneumon ovulorum* L., according to HALIDAY a species of *Mymar*, and also the genus *Teleas*.

Comp. on this family C. G. NEES VON ESSENBECK, *Hymenopterorum Ichneumonibus affinium Monographiæ*, Stuttgartiæ et Tubingæ, 1834, 8vo. II. pp. 311—397; and WESTWOOD, *Introd. to Modern Classific. of Ins.* II. pp. 167—173; as also the works of HALIDAY there referred to, and other English entomologists.

*Mymar* HALIDAY. (Palps none?) Antennæ 13—10 jointed in males, long, broken, 10—9 jointed, clavate in females. Wings narrow, often linear, anterior broader at the extremity (spatulate), ciliated on the margin. Abdomen in some sessile, in others petiolate.

Sp. *Mymar pulchellus* WALKER, GUÉRIN, *Iconogr. Ins.* Pl. 68, fig. 6; HERRICH-SCHÆFFER, *Deutschl. Ins.* Heft 184, Tab. 135, (fig. copied in CURTIS, *Brit. Entom.* Tab. 411).

*Note.*—Here belong various sub-genera constituted by HALIDAY, on which comp. WESTWOOD, l. l. *Generic Synopsis*, pp. 78, 79.

*Platygaster* LATR. (with the addition of genera *Scelio* and *Teleas* ejusd.) Palps short. Abdomen depressed, sessile or affixed by a short petiole. Antennæ broken, with ten or twelve joints, in females incrassated towards the apex.

Sp. *Teleas læviusculus* RATZEBURG, *Forst-Insekten*, III. Tab. VIII. fig. 8; the larva lives in the eggs of the *Bombyx pini*; in those of *Bomb. neustria* lives the larva of *Teleas terebrans* RATZEBURG, *Teleas ovulorum* BOUCHÉ.

Add genus *Iphitrachelus* HALID. (tarsi with four joints); other sub-genera of this author are enumerated in WESTWOOD, *Generic Synops*, pp. 77, 78.

*Sparasion* LATR. Abdomen depressed, sessile. Antennæ inserted below the frons, twelve-jointed. Maxillary palps long, filiform, five-jointed, labial three-jointed. Wings almost without nervures, with stigma distinct.

Sp. *Sparasion frontale* LATR., *Ceraphron cornutus* JURINE, *Hymén.* Pl. 13, fig. 44, CUVIER *R. ani éd. illustr., Ins.* Pl. 116, fig. 1. HERRICH-SCHÆFFER, *Deutschl. Ins.* Heft 184, Tab. 25.

*Ceraphron* JURINE (in part). Abdomen subsessile, conico-acuminate. Antennæ broken, with eleven or twelve joints, the first elongate. Maxillary palps long, four-jointed, labial with two or three joints. Wings without nervures, in some none.

Sub-genera: *Megaspilus* WESTW., *Microps* HALID., *Calliceras* NEES.

Sp. *Ceraphron sulcatus* JURINE, *Hymén.* Pl. 14.

*Dryinus* LATR., *Gonatopus* KLUG., DALM. Abdomen convex, subsessile. Antennæ ten-jointed, porrect, mostly short or moderate. Mandibles somewhat prominent, acute, frequently dentate. Maxillary palps elongate, five- or six-jointed. Anterior wings with stigma pretty conspicuous, and radial cell incomplete, with two brachial cells; posterior wings increased by a lobe, in some no wings.

*a*) With anterior tarsi of females raptorial.

Sub-genera: *Dryinus* LATR., *Anteon* LATR., *Chelogynus* HALID., *Gonatopus* LJUNG.

Sp. *Dryinus cursor* HALID., GUÉRIN, *Iconogr., Ins.* Pl. 68, fig. 1, HERRICH-SCHÆFFER, *Deutschl. Ins.* Heft 184, Tab. 21, (fig. cop. in CURTIS, *Brit. Entom.*); — *Dryin. formicarius* LATR., *Gener. Crust. et Ins.* I. Tab. XII. fig. 5, &c.

*b*) With anterior tarsi of females simple.

*Bethylus* LATR., *Omalus* JURINE, NEES. (Maxillary palps sex-articulate.)

Sp. *Bethylus cenopterus, Tiphia cenoptera* PANZER, *Deutsch. Ins.* Heft 81, Tab. 14, &c.

Add sub-genera *Aphelopus* DALM., NEES, *Myrmecomorphus, Embolemus, Epyris* WESTWOOD, l. l. p. 76.

*Proctotrupes* LATR., *Codrus* JURINE, NEES. Abdomen conico-petiolate, with anal segments attenuated to form a curved tubule sheathing the borer. Antennæ inserted in middle of frons, thirteen-jointed in both sexes, straight, porrect. Maxillary palps four-jointed, much longer than labial. Superior wings with longitudinal nervures and stigma distinct.

Sp. *Procotrupes campanulator, Bassus campanulator* FABR., GERMAR, *Faun. Ins. Europ.* Fasc. v. Tab. 16; *Proctotrupes pallipes,* JURINE, *Hymén.* Pl. 13, fig. 46, &c.

*Diapria* LATR., *Psilus* JURINE. Abdomen petiolate, campanulate. Antennæ inserted in frons, with 12—15 joints. Maxillary palps elongate, five-jointed. Wings often without nervures, and with stigma little distinct or none.

Sp. *Diapria verticillata, Psilus elegans,* JURINE, *Hymén.* Pl. 13, fig. 48; *Diapria cornuta,* PANZER, *Deutschl. Ins.* Heft 83, Tab. 11, &c.

Add sub-genera *Helorus* LATR., *Belyta* LATR. (*Belyta* JURINE and *Cinctus* ejusd.), and several genera of recent authors, principally English, on which comp. WESTWOOD, l. l. pp. 75, 76.

Family XX. *Chalcidiæ s. Chalcides.* Posterior wings without nervures or with a single nervure submarginal, short; anterior with only one cubital cell, imperfect, radial cell mostly wanting. Antennæ with joints various in number, not more than thirteen, with first joint elongate, almost always geniculate, often thicker towards the extremity. Head anteriorily bisulcate for receiving first joint of antennæ. Palps very short. Borer originating from a chink of inferior surface of abdomen remote from apex, mostly concealed or exsert at the termination alone.

The *Chalcidiæ* are small Insects, mostly shining with metallic lustre, many species of which are able to leap, though that is not always the case where the ability might be inferred from the thickness of the hind-feet. Their larvæ live parasitically in those of other insects, especially of *Lepidoptera* and *Hymenoptera*, and also in their eggs; they are small maggots without feet. The pupæ are mostly not included in a web. The number of species of this division is extraordinarily great; in Great Britain alone nearly 1200 species have been found.

Comp. on this family amongst others, SPINOLA, *Essai d'une nouvelle Classification des Diplolépaires, Ann. du Mus.* XVII. 1811, pp. 138—152; NEES VON ESSENBECK, *Hymenopt. Ichneumonib. aff. Monogr.* II. pp. 1—310. (*Monographia Pteromalinorum*, amongst which some families are arranged that belong to the preceding family); the monographs of DALMAN and BOHEMAN, in the Trans. of the Swedish Acad. at Stockholm, for 1820 and 1833; BOYER DE FONSCOLOMBE, *Monogr. chalciditum*, &c., *Ann. des Sc. natur.* XXVI. 1832, pp. 273—307, and WALKER, *Descriptions of the British Chalcidites* in *Ann. of Nat. Hist.* Vol. I—IV. 1838, 1839.

A. Prothorax narrower than mesothorax, attenuated towards the head. Femora of posterior feet scarcely larger than the rest; tibiæ straight.

*Eulophus* GEOFFR., LATR., *Entodon* DALM. Antennæ with seven or eight joints, very rarely with nine, in males sometimes ramose (pectinate with three internal branches). Tarsi with four joints.

Sp. *Eulophus pectinicornis, Ichneumon pectinicornis* L., GUÉRIN, *Iconogr. Ins.* Pl. 67, fig. 15, &c.

Add sub-genus *Cirropsilus* WESTW., and several more, on which comp. WESTWOOD, *Introd. to modern Classification of Ins.* II. *Generic Synopsis*, pp. 73—75.

*Encyrtus* LATR. Antennæ eleven- or twelve-jointed. Intermediate feet longer than rest, with tibiæ terminated internally at the extremity by a strong spine.

Species numerous; here belongs a figure of SCHELLENBERG, Tab. XIV. of *Mira mucora* by name, placed wrongly amongst the Diptera.

On several sub-genera, to be referred to *Encyrtus*, comp. WESTWOOD, l. l., pp. 72, 73.

*Pteromalus* SWEDER. (in part), LATR., (species of *Diplolepis*, FABR.) Antennæ eleven- to thirteen-jointed. Middle feet like the rest.

Sp. *Pteromalus puparum, Ichneumon puparum* L., GŒDÆRDT, *Metam. natur.* I. Tab. 77, p. 144, RŒSEL, *Ins.* II. *Bombylior. et Vespar.* Tab. III. &c.

Add genera *Cleonymus* LATR., *Perilampus* ejusd. and numerous sub-genera of more recent authors; on which comp. WESTWOOD, l. l. pp. 67—72.

Does genus *Eucharis* LATR. also belong here? Prothorax short, narrow, mesothorax gibbous, elevated. Antennæ moniliform, eleven- or twelve-jointed, straight. Abdomen with long petiole. Feet slender, with posterior femora not incrassated.

Sp. *Eucharis adscendens, Cynips adscendens* PANZER, *Deutschl. Ins.* Heft 88, Tab. 18, &c.

B. Prothorax transversely quadrate.

1) Posterior feet not much differing from anterior, with tibiæ straight.

*Eurytoma* ILLIG., LATR. Antennæ eleven- to thirteen-jointed, in males longer, with joints distinct, nodose.

Add genus *Spalangia* LATR., and other sub-genera; on which see WESTWOOD, l. l. pp. 66, 67.

*Toracantha* LATR.

2) Posterior feet with femora very large, ovato-lenticular, with tibiæ arcuate.

*Chalcis* FABR., LATR. Prothorax much broader than long. Antennæ eleven- or thirteen-jointed, thicker towards extremity. Borer concealed.

Sp. *Chalcis minuta* FABR., *Chalcis femorata* DALM., PANZER, *Deutschl. Ins.* Heft 32, Tab. 6, DUMÉR. *Cons. gén. s. l. Ins.* Pl. 34, fig. 1, &c. (Sub-genus *Brachymeria*, WESTW.)

Sub-genus *Chirocera* LATR. (With antennæ of males pectinate).

*Dirhinus* DALM.

*Palmon* DALM.

*Conura* SPINOLA. (With abdomen conical, acuminate.)

Sp. *Conura flavicans* SPINOLA, GUÉRIN, *Magasin de Zool.* 1837, *Ins.* Pl. 180; hab. in Brasil.

On some other sub-genera comp. WESTWOOD, l. l. p. 66.

‡ *Leucospis* FABR. Thorax gibbous, prothorax transversely quadrate. Upper wings doubled longitudinally. Antennæ with twelve or fifteen joints, incrassated at apex. Borer reflected above the back.

Sp. *Leucospis gigas* FABR., KLUG., PANZER, *Ins.* Heft 84, Tab. 17, 18, CUV. *R. ani. éd. ill., Ins.* Pl. 116, fig. 6. *Leucospis intermedia* ILLIG., *Leuc. dorsigera* PANZER, *Deutschl. Ins.* Heft 15, Tab. 17, DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 34, fig. 2, &c.

This genus contains species of ½ inch and more, whilst the smallest species are still more than 3 lines in size, so that it may be considered gigantic in this family of dwarfs. In Europe species of *Leucospis* are found in the southern regions alone, principally in Italy. To the extrication of the synonomy ILLIGER, KLUG, and lately WESTWOOD, have contributed: see the monograph of the last-named author, *Entomol. Magas.* II. p. 212, &c.

Family XXI. *Ichneumonides.* Wings four, veined, the anterior always furnished with complete cells. Maxillary palps distinct, elongate. Antennæ mostly setaceous or filiform, long, with numerous joints. Body elongate, slender. Ovipositor straight, often exsert, bivalved, including a borer of three setæ.

*Slip-wasps, Ichneumons.* We unite in this family the *Ichneumonides* and *Evaniales* of the systematic entomologists of recent times. Of many species the economy is yet unknown, yet of all whose mode of life has been observed the larvæ are found in other insects, and nearly always in the larvæ of these. They are especially caterpillars, the larvæ of *Lepidoptera*, in which *Ichneumons* lay their eggs; the larvæ of *Evania* are parasites of the genus *Blatta*, and probably live, according to an observation of MAC LEAY (related by WESTWOOD, *Introd. to mod. Classif. of Ins.* I. p. 422) in the membrane of their eggs.

Comp. on this family amongst others:

J. J. TERNTEPOHL, *Revisio critica generis Ichneumonis.* OKEN'S *Isis*, 1826, pp. 55—87, pp. 293—308.

J. L. C. GRAVENHORST, *Ichneumonologia europæa.* Vratislaviæ, 1829, III. Vol. 8vo.

NEES AB ESSENBECK, *Hymenopterorum Ichneumonib. affin. Monographiæ.* Volumen Ium.

J. T. C. RATZEBURG, *Die Ichneumonen der Forstinsekten.* Berlin, 1844, 4to.

Phalanx I. *Ichneumones.* Abdomen inserted between the two posterior feet. Antennæ mostly setaceous or filiform, composed of

a great number of joints (sixteen, and many more[1]). Maxillary palps, mostly five, articulate.

A. *Ichneumones adsciti, s. Braconides.* A discoidal cell under the first cubital cell extended to the margin of wing, not divided by a recurrent nervure. Second cubital cell frequently large.

*Aphidius* NEES. Head transverse, with vertex broad. Abdomen affixed by a short cylindrical petiole, incurvatile beneath the thorax. Borer not exsert. Antennæ with joints very distinct, rather few (eleven to twenty-four). Maxillary palps shortish (five- or four-jointed).

Sp. *Ichneumon Aphidum* L., *Aphidius varius* NEES, DE GEER, *Ins.* II. Pl. 30, f. 12, 13. (The fig. of PANZER, *Deutschl. Ins.* Heft 95, Tab. 13, also belongs to this species according to NEES.) This small species lays its eggs in Plant-lice, in each one a single egg. The pupa of the *Ichneumon* lies curled up in the body of the *Aphis*. See LEEUWENHOECK, *Sevende vervolg van Brieven*, bl. 225—294, 134e Missive van 26 Oct. 1700, (and the fig. bl. 217—281), also DE GEER, l. l. pp. 866—875[2].

Sub-genera: *Trioxys* HALID., *Monoctonus* ejusd., *Toxares* WESTW. (*Trionyx* HALID.), *Ephedrus* HALID., *Praon* HALID.

*Alysia* LATR. Head broad. Abdomen sessile. Borer exsert. Mandibles subquadrate, with apex tridentate, divaricate (even when drawn together, distant). Maxillary palps sexarticulate. Antennæ moderate or long, with more than twenty joints.

Sp. *Alysia manducator, Ichn. manducator*, PANZER, *Deutschl. Ins.* Heft 72, Tab. 4, GUÉRIN, *Iconogr. Ins.* Pl. 66. fig. 11, &c. The larvæ of many species of this genus live in the pupæ of *Diptera*, others in the larvæ of *Scarabæi*.

Sub-genera: *Cœlinius* NEES (comp. HERRICH-SCHÆFFER *Deutsch. Ins.* Heft 153, 154, 156), *Chænusa, Chorebus, Dacnusa, Œnone, Chasmodon* HALIDAY, (WESTWOOD, *Generic Synops.* f. 65), *Copidura* SCHIÖDTE.

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[1] Some species of the genus *Aphidius* NEES, of which HALIDAY forms the genus *Ephedrus*, make an exception to this, and have only eleven or twelve joints in the antennæ.

[2] These small parasites have their own in return: larvæ of *Cynips*, parasites of the second order. See GOEZE, *Naturforscher*, XII. 1778, s. 197—220.

*Bracon* FABR. (in part), LATR. Clypeus exscinded, a hiatus being left above the mandibles. Maxillary palps quinquearticulate. Head transverse or subglobose.

Sp. *Bracon impostor* NEES, *Bracon denigrator* FABR. (excl. syn. L.), PANZER, *Deutschl. Ins.* Heft 45, Tab. 14, &c.

*Rogas* NEES. (See WESTWOOD, l. l. p. 64 for other sub-genera).

*Sigalphus* LATR. (*Chelonus* JURINE). Clypeus entire. Abdomen fornicate beneath, triannulate above, or continuous, no vestige of incisures remaining, with all the segments united into one. Maxillary palps sexarticulate, labial shorter, quadriarticulate.

Sp. *Sigalphus irrorator*, *Cryptus irrorator* FABR., DE GEER, *Ins.* I. Tab. 36, fig. 12; GUÉRIN, *Icognogr., Ins.* Pl. 68, fig. 9 (in this figure the division of the nervures in the wings is incorrectly represented as though there were a second recurrent nerve, as in the *Ichneumones genuini*); 4½ lines long; expanded wings 8 lines; abdomen glistering at the extremity with brownish green from fine smooth hairs, wings brownish with blacker external margin and a white spot in the middle under the radial cell. The larva, according to DE GEER, lives in the caterpillar of *Noctua psi*, l. l. p. 577.

*Helcon* NEES.

*Microgaster* LATR.

*Note.*—For other genera and sub-genera, here omitted on account of our limited space, the works recommended above may be consulted.

B. *Ichneumones genuini*. Recurrent nerves two, one dividing the area situated under the cubital cells. First cubital cell large, confluent with the first discoidal cell; second cubital cell rhombic, pentagonal or trigonal, very small, in some none. Maxillary palps with five joints, labial palps with four joints.

In this division no such small species occur as in the preceding (ex. gr. the genus *Aphidius*). The larvæ live principally in caterpillars. Some species do not lay their eggs *in* the caterpillars, but fasten the eggs, which are provided with a pedicle for the purpose, *on* the skin of the caterpillars. See HARTIG, *Ueb. d. gestielten Eier der Schlupfwespen*, WIEGMANN'S *Archiv*, 1837. s. 151—158. Taf. IV.

GRAVENHORST has described more than 1600 species of *Ichneumones genuini*; a number which will be continually increased by fresh observers.

† Genuine Ichneumons, with abdomen convex or depressed.

α) *With abdomen petiolate or sub-petiolate.*

*Ichneumon* L. (exclusive of many species). Head narrower than thorax. Borer subexsert or concealed. Second cubital cell distinct, mostly pentagonal.

Sp. *Ichneumon sputator* FABR., PANZER, *Deutschl. Ins.* Heft 19, Tab. 20; —*Ichn. Troscheli* RATZEB., in the caterpillar of *Noctua piniperda.*

*Tryphon* FALL. Head narrower than thorax. Borer subexsert or concealed. Second cubital cell almost obsolete, triangular. Abdomen elongate.

On this genus, which contains very numerous species, comp. GRAVENHORST, *Ichneumol.* II. pp. 1—368.

Add sub-genus *Polyblastus* HARTIG, SCHIÖDTE.

*Megastelus* SCHIÖDTE.

*Trogus* PANZER, GRAVENH. Head transverse. Borer concealed. Second cubital cell triangular or quinquangular. Scutellum gibbous, prominent. Abdomen distinctly petiolate, oblong.

*Trogus lutorius, Ichneum. lutorius* FABR., DE GEER, II. Pl. 29, fig. 9, p. 848; one of the largest native hymenoptera, 10 lines to 1 inch long; thorax black, scutellum sulphur-yellow, feet and head yellow beneath, abomen red-brown, at the extremity blackish. The larva lives in the caterpillar of *Sphinx ocellata, Sph. pinastri,* &c.

*Alomya* PANZER, GRAVENH.

*Cryptus* FABR. Head transverse. Abdomen oval, distinctly petiolate. Borer exsert.

*Note.*—Some species are distinguished by their small size, the defect of wings, or by rudiments alone of wings: sub-genus *Pezomachus* GRAVENH., Sp. *Crypt. nigro-cinctus, Ichn. pedicularius* PANZER, *Deutschl. Ins.* Heft 81, Tab. 13, &c.

Add genus *Cylloceria* SCHIÖDTE, see GUÉRIN, *Magas. de Zool.* 1839, *Ins.* Pl. 9, 10.

*Xorides* LATR.

*Acœnitus* LATR.

† β) *With abdomen sessile (extremely short petiole).*

*Pimpla* FABR. Head transverse. Borer exsert, long. Antennæ long, filiform, slender, with numerous joints. Mandibles bifid at apex.

*a)* With second cubital cell evanescent.

Sub-genera: *Glypta* GRAVENH., *Polysphincta* ejusd., *Schizopyga* ejusd., *Clistopyga* ejusd.

*b)* With second cubital cell distinct, mostly triangular.

Sub-genera: *Rhyssa* GRAV., *Trachyderma* ejusd., *Ephialtes* SCHRANK, GRAV., *Pimpla* GRAV., *Lissonota* GRAV.[1]

Sp. *Pimpla* (*Ephialtes*) *manifestator*, *Ichneumon manifestator* L., PANZER, *Deutschl. Ins.* Heft 19, Tab. 21, DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 32, fig. 1. CUV. *R. ani., éd. ill., Ins.* Pl. 110, fig. 8, &c.

*Metopius* PANZ., GRAVENH., (*Peltastes* Illig.)

Sp. *Ichneumon necatorius* FABR., *Ichn. vespoïdes* PANZ., *Deutschl. Ins.* Heft 47, Tab. 19.

*Bassus* FABR., GRAV.

†† Genuine Ichneumons with abdomen compressed.

*Banchus* FABR. Abdomen sessile, or with very short petiole.

*Ophion* FABR. Abdomen falcate, distinctly petiolate. Antennæ slender, filiform.

Sub-genera: *Anomalon* JURINE (in part), GRAVENH., *Ophion*, *Paniscus*, &c.

Sp. *Ophion glaucopterus* FABR.;—*Ophion circumflexus*, *Ichneum. circumflexus* L., RATZEB. *Forst. Ins.* III. Tab. VI. fig. 2, &c.

*Hellwigia* GRAV. Abdomen petiolate. Antennæ clavate.

Comp. GRAVENHORST, *Hellwigia, novum insectorum genus; Nov. Act. Acad. Cæs. Leop. Car. Natur. Curiosor.* XI. 1823, pp. 315—322, Tab. 43.

Phalanx II. *Evaniales.* Abdomen inserted into thorax above, before the origin of the two posterior feet. Antennæ filiform or setaceous, with thirteen or fourteen joints. Anterior wings with distinct cells, posterior veined, destitute of cells. Maxillary palps longer, sexarticulate, labial quadriarticulate. Posterior feet with coxæ long and strong, and femora often incrassate.

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[1] Of what small value this second cubital cell or areola is as a character in *Pimplæ*, appears from some species of *Lissonota* GRAVENH., where it almost entirely disappears, or is sometimes present on the right wing and wanting on the left. GRAVENHORST, l. l. VIII.

A. Abdomen of moderate size or elongate.

† Borer exsert.

*Aulacus* JURINE. Abdomen compressed. Antennæ setaceous.

Sp. *Aulacus striatus*, JURINE, *Hymén.* Tab. 7, fig. 13: habit. on the mountains of Switzerland.

*Fœnus* FABR. Abdomen elongate, clavate at apex, exceeding the length of head and thorax. Antennæ filiform.

Sp. *Fœnus jaculator*, *Ichneumon jaculator* L., RÉAUMUR, *Ins.* IV. Pl. 10, figs. 14, 15, PANZER, *Deutschl. Ins.* Heft 96, Tab. 16, DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 32, fig. 2, &c.

†† Borer concealed.

*Pelecinus* LATR., FABR. Inferior wings almost without nervures. Abdomen very long, filiform in females, moderate and clavate in males.

Sp. *Pelecinus polyceratur* LATR., GUÉRIN, *Iconogr., Ins.* Pl. 65, habit. in North and South America.

Comp. on this genus LEPELETIER and SERVILLE, *Encyl. méthod., Ins.* Tom. x. 1825, pp. 29, 30; DE ROMAND, *Note sur le genre Pelecinus*, GUÉRIN, *Mag. de Zool.*, 1840, *Ins.* Pl. 48, 49; ejusd. *Notice s. l. genre Pelec.*; ibid. 1842, Pl. 86; KLUG, *die Arten der Gattung, Pelec.*, GERMAR'S *Zeitschr. f. d. Entom.* III. 1841, s. 377—388, Tab. II. (A genus in the opinion of this author related to the *Oxyura*, the genus *Monomachus* WESTW., forming the transition to the genus *Proctotrupes*.)

B. Abdomen very short, ovato-triangular, compressed, abruptly petiolate, often inserted almost beneath the scutellum.

*Evania* FABR., LATR.

Sp. *Evania appendicigaster*, KIRBY and SPENCE, *Introd. to Entom.* Pl. IV. fig. 2, DUMÉR. *Cons. gén. s. l. Ins.* Pl. 32, fig. 3, &c.

Sub-genera: *Brachygaster* LEACH, *Hyptia* ILLIG. Comp. on this genus and the allied sub-genera SPINOLA, GUÉRIN, *Revue Zoolog.* 1840, pp. 244—248, and WESTWOOD, *Trans. of the Entom. Soc. of Lond.* III. 1843, p. 237, &c.

Family XXII. *Cynipsea s. Gallicolæ.* Posterior wings with no nervure or one only, anterior with radial cell, and two or three cubital cells, the second triangular, third incomplete produced to apex of wing. Antennæ of the same thickness, or gradually thicker towards the apex, with twelve to fifteen joints. Maxillary

palps four- or five-jointed, labial with two or three joints. Thorax gibbous, with mesothorax very large. Abdomen compressed. Borer extremely slender, with three setæ, concealed, rolled spirally, between a bivalve sheath, exsertile from the last ventral channelled segment of abdomen.

*Gall-wasps.* The females of this family pierce different parts of plants (leaves, leaf-stalks, buds, &c.) and lay an egg in the wound. The irritation thus produced causes the sap to flow in greater abundance to the wounded part, and thus different excrescences, often of very singular kinds, arise, which serve the larva both for food and habitation. The form of the excrescences is different for different species, and may serve for recognising and distinguishing them. The larvæ, bent into a semicircle, lie as thick white maggots in the cavity of these excrescences. Some species undergo their metamorphosis in this situation; others leave it before becoming nymphs, and change under ground. It is true that species also of *Chalcides* are found in these excrescences, which were formerly placed with species of *Cynips* in one genus, and to which GEOFFROY gave the name of *Cynips* exclusively, which occasioned much confusion in the nomenclature: they are ichneumons which have taken the place of the natural inhabitants.

Gall-wasps, although living upon vegetable food, have nevertheless a great affinity with the *Ichneumonides*, and this is shewn more distinctly by the fact that some species (*Allotria* WESTW.) really live like ichneumons in insects (*Aphides*), without on that account differing from the rest of the *Cynipides* by natural characters or organisation (WESTWOOD, *Introd. to modern Classificat. of Ins.* II. p. 132, RATZEBURG, *Die Forst-Insecten*, III. p. 54).

To the excrescences, caused by gall-wasps, belong also the gall-nuts or gall-apples, of which those that come from the East (from *Aleppo*) are in most esteem. They consist, besides gallic acid, in great measure of tannin, and are consequently very astringent. Hence their use in medicine. Their property of forming a black precipitate with salts of oxyde of iron, causes these gall-nuts to be employed in the preparation of writing-ink.

Comp. on this family: MALPIGHIUS *de Gallis*, in *Anatomes plantarum parte alterâ* (*Operum* ed. Londin. 1686, fol. Tomo II. pp. 17—38); OLIVIER, *Encycl. méth., Hist. nat. des Ins.* V. 1790, pp. 772—792, BRANDT u. RATZEBURG, *Medizin. Zoolog.* II. s. 144—158; BOYER DE FONSCOLOMBE, *Description des Ins. de la fam. des Diplolépaires qui se*

*trouvent aux environs d'Aix, Ann. des Sc. nat.* XXVI. 1832, pp. 184—198; J. O. WESTWOOD, *Insector. nonnullor. e familia Cynipidarum descriptiones;* GUÉRIN, *Magas. de Zool.* 1837, *Ins.* Pl. 179; HARTIG, *Ueb. die Familie der Gallwespen;* GERMAR'S *Zeitschr. f. d. Entom.* II. 1840. s. 176—209, III. 1841. s. 322—358, IV. 1843, s. 395—422.

*Cynips* L. (exclusive of some species), *Diplolepis* GEOFFR.

Sub-genera: *Allotria* WEST., (*Xystus* HARTIG), *Anacharis* DALM. (*Megapelmus* HARTIG), *Leiopteron* PERTY, WESTW., *Peras* WESTW., *Figites* LATR., *Biorhyza* WESTW. (*Apophyllus* HARTIG), *Cynips* LATR., WESTW., *Ibalia* LATR., and others; on which see WESTWOOD, *Generic Synops.* pp. 55, 56, and HARTIG, l. l.

Sp. *Cynips Gallæ tinctoriæ* OLIVIER, *Voyage dans l'empire Othoman,* Paris an 9, *Atlas,* Pl. 15, BRANDT u. RATZEBURG, *Mediz. Zool.* II. Tab. XXI. fig. 11—13; this species lives on *Quercus infectoria* in Asia Minor, Syria, &c.; —*Cynips Quercus folii* L., RŒS. *Ins.* III. Suppl. Tab. 52, 53, f. 10, 11;—*Cyn. Rosæ* L., RÉAUMUR, *Ins.* III. Pl. 46, fig. 5–7, Pl. 47, fig. 1–4, BLANKAART, *Schouburg,* Tab. 16, fig. v–z, BRANDT u. RATZEBURG, l. l. Tab. XXI. fig. 5–7, on the wild or garden-rose, in which it causes mossy excrescences named Dog-rose-sponge or *Bedeguar.*

*Note.*—Abdomen in most extremely short-petiolated. Some are distinguished by their long petiole (sub-genera *Anachoris, Leiopteron,* &c.) Males are distinguished from females by their small size, longer antennæ, mostly also by the third joint of their antennæ being sinuated outwards. Of some species the females alone are known.

Family XXIII. *Urocerata* (*Siricidæ* CURTIS). Abdomen sessile, continuous with thorax, covering the origin of posterior feet, cylindrical or oblong. Mandibles short, thick. Wings both anterior and posterior with distinct cells. Tibia of first pair of feet with a single terminal spine. Borer of females in some exsert, straight, with three setæ, received between two horny valves, in others capillary, contorted at the base, contained in abdomen. Larvæ furnished with six feet, phytophagous.

The larvæ of the chief genus of this division *Sirex* live in wood, especially fir and pine, some also in beech, poplar and birch. Of others the larvæ are still unknown. DAHLBOM suspects that the larva of *Oryssus* lives on gall-nuts. The opinion of SPINOLA and LEPELETIER that the larvæ live parasitically in those of wood-eating insects, like ichneumons, is an error, and rests on imperfect observation.

Comp. on this family: F. KLUG, *Monographia Siricum Germaniæ*, Tab. æn. Berolini, 1803, 4to, and (on the following also) the excellent work of TH. HARTIG, *Die Familien der Blattwespen und Holzwespen*. Mit Abbild. Berlin, 1837, 8vo.

Phalanx I. *Oryssides*. Borer capillary, incurved at base, concealed. Radial cell one, cubital cells two.

*Oryssus* LATR. Antennæ short, with ten to twelve joints, inserted near the mouth. Maxillary palps long, five-jointed, labial triarticulate. Anterior tarsi of females with three joints only.

Sp. *Oryssus coronatus* FABR., PANZER, *Deutschl. Ins.* Heft 52, Tab. 19 (*Sirex vespertilio*), DUMÉR. *Cons. gén. s. l. Ins.* Pl. 35, fig. 4; in Germany, France, &c.

Phalanx II. *Uroceridæ*. Borer straight, exsert. Radial cells two, cubital four. Antennæ with eighteen to twenty-five joints.

*a) With maxillary palps long, 6- or 5-jointed.*

*Cephus* LATR., FABR. Antennæ incrassated towards the apex. Abdomen compressed.

Sp. *Cephus spinipes*, *Banchus spinipes* PANZER, *Deutschl. Ins.* Heft 73, Tab. 17, &c.

(Species small. This genus is placed in the following family by LATREILLE and WESTWOOD).

*Xiphydria* LATR., FABR. Antennæ attenuated towards the apex, setaceous.

Sp. *Xiphydria camelus*, *Sirex camelus* L., DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 36, fig. 2, HARTIG l. l. Tab. VIII. fig. 9, &c.

*b) With maxillary palps extremely short, with only one or two joints.*

*Sirex* L. (exclusive of species). *Urocerus* GEOFFR. Antennæ setaceous or filiform, long. Maxillæ united at the base.

Sp. *Sirex gigas* L., *Ichneumon gigas*, *Syst. nat.* Ed. X. fem. (*Sirex mariscus* L. ma.), RÖSEL, *Ins. Bomb. et Vesp.* Tab. VIII. IX., DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 36, fig. 1, RATZEBURG, *Forst-Ins.* III. Tab. IV. fig. 2 F; head black, with a large yellow spot on each side behind the eyes; the male with stone-coloured abdomen, the last two rings black; the female has the abdomen at the base and apex yellow, in the middle dull black. This insect is the largest native hymenopterum; the expanded wings measure 2 in. 2 lin., the body 1 in. 2 lin., and the borer 4 lin.; but much smaller specimens of the species are met with. The larva lives more than a year in the wood before it changes into a nymph; in summer the insect comes to view from the pupa after three weeks, but when the larva becomes a pupa towards winter, it continues thus throughout the winter.

Family XXIV. *Tenthredineta* s. *Serrifera.* Abdomen sessile, continuous with thorax, covering the origin of posterior feet, cylindrical or ovato-oblong. Mandibles large, horny, acuminate, incurved, mostly tridentate. Maxillary palps mostly sexarticulate, labials four-jointed or quadriarticulate. Labium cloven into three laciniæ. Wings both anterior and posterior furnished with distinct cells. Borer almost always occult, included in a bivalve sheath, compressed, cultrate, mostly serrate, composed usually of four setæ (the upper one of other hymenoptera being here cloven to the base). Tibiæ of anterior feet with two terminal spines. Larvæ (similar to caterpillars) with mostly twenty-two or twenty feet, feeding on leaves.

*Leaf-wasps.* The larvæ mostly eat leaves like caterpillars, some live in gall-excrescences. These insects are often very destructive to trees, and the knowledge of them is therefore very important to the forester. Some also injure our potherbs.

On this family, besides the *Monograph* of HARTIG noted above and the third part of the *Forst-Insecten* of RATZEBURG, may be consulted: KLUG, *Die Blattwespen der Fabrizischen Sammlung;* WIEDEMANN'S *Zoologisches Magazin,* I. 3, 1819, s. 84—91, Tab. II., and by the same, *Uebersicht der Tenthredinetæ der (Berliner) Sammlung,* in his *Jahrbücher der Insektenkunde,* I. Bd. 1834, 8vo, s. 223—253, Taf. II. figs. 5—10; G. DAHLBOM, *Clavis novi Hymenopterorum systematis adjecta synopsi larvarum scandinavicar. eruciformium,* Lundæ, 1835.

A. Borer exsert.

*Xyela* DALMANN, *Mastigocera* KLUG. Antennæ thirteen-jointed, with fourth joint longest (equalling or surpassing in length the nine terminal joints taken together). Borer of females of the length of abdomen.

B. Borer occult.

*a*) Antennæ with numerous joints, (fifteen to thirty-six).

*Lyda* FABR., HARTIG, *Pamphilius* LATR. Antennæ setaceous (nineteen- to thirty-six-jointed). Radial cells two, cubital four. Posterior tibiæ with three lateral spines.

The larvæ of this genus live together socially in a web; they have, besides the six horny feet on the thoracic segments, only two propellers directed outwards at the hind part of the body. Comp. HARTIG l. l. Tab. VII. figs. 1—16, and RATZEBURG, *Forst-Insekten.* III. Tab. I.

*Tarpa* FABR., HARTIG, *Magalodontes* LATR. Antennæ shortly pectinate on the inside (fifteen- to eighteen-jointed). Radial cells two, cubital four. Posterior tibiæ with two lateral spines.

Comp. KLUG, *Entomol. Monographien*, Berlin 1824, 8vo, s. 181—196.

*Lophyrus* LATR. Antennæ in males pectinate, in females serrate (seventeen- to thirty-jointed). Radial cell single, cubital cells four.

Sp. *Lophyrus Pini*, *Tenthredo Pini* L., RATZEBURG l. l. Tab. II. fig. 1; *Lophyr. rufus*, &c. The larvæ have 22 feet[1].

*b*) Antennæ with mostly nine joints or fewer.

*Tenthredo* L. (exclusive of many species), LATR., *Allantus* JURINE (with addition of some sub-genera). Antennæ nine- to eleven-jointed, simple. Radial cells mostly two, cubital four. Labrum exsert.

Sub-genera: *Macrophya* DAHLB., *Tenthredo* HARTIG, *Allantus* JURINE, *Athalia* LEACH, *Selandria* LEACH, *Dinura* DAHLB., *Phyllotoma* FALLÉN, *Fenusa* LEACH, *Emphytus* KLUG, *Pelmatopus* HARTIG, *Dolerus* JURINE, *Cryptocampus* HARTIG, *Nematus* JURINE, *Cladius* ILLIG., and others which are recorded in WESTWOOD, *Generic Synops.* pp. 52—54.

(Areolæ of wings and antennæ are used for subdivisions).

Sp. *Tenthredo difformis* (*Cladius*), PANZER, *Deutsch. Ins.* Heft 62, Tab. X. (male with antennæ pectinate in middle); *Tenthredo centifoliæ* (*Athalia*), PANZER, *Deutsch. Ins.* Heft 49, Tab. XVIII.[2]; *Tenthr. grossulariæ* DAHLB., BLANKAART, *Schouburg*, Tab. IX. figs. G—J; *Tenthredo gallicola* (*Nematus*) WESTW., SWAMMERDAM, *Bib. Nat.* Tab. XLIV., RŒSEL, *Ins.* II., *Bombyl. et Vesp.* Tab. X. figs. 1—4 (*Tenthredo gallifex* HAGENB. in MSS.) &c. The larvæ have twenty or twenty-two feet.

*Hylotoma* LATR. (and *Schizocera* ejusd.) Antennæ triarticulate, with third joint elongate, in males of some species forked (*Schizo-*

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[1] Comp. on this genus L. FINTELMANN, *Zur Naturgesch. einiger auf der Kiefer lebender Lophyren; Nov. Act. Cæs. Leop. Car.*, Tom. XIX. P. 1, 1839, pp. 245—280, Tab. XXV.

[2] On this insect, whose larva may be very destructive to turnips by eating the young leaf, we have an excellent monograph by G. NEWPORT, *Observ. on the Anat. and Economy of Athalia centifoliæ; Prize Essay of the Entomol. Soc. With a plate.* London, 1838, 8vo.

*cera*). Radial cell one, sometimes with accessory apical cell; cubital cells four or three (*Ptilia* LEPELET.)

Sp. *Hylotoma rosarum* FABR. (not *Tenthr. rosæ* L.) RŒSEL, II. *Bombylior. et Vespar.* Tab. II., DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 35, fig. 6, &c. (*Tenthr. rosæ* L. is a species of *Athalia*.)

*Cimbex* OLIV. Antennæ clavate, five- to seven-jointed. Radial cells two, cubital three.

Sp. *Cimbex variabilis* KLUG, *Tenthredo lutea* L. (and *Tenthr. femorata* ejusd.), RŒSEL, *Ins.* II., *Bomb. et Vesp.* Tab. XIII., RATZEBURG, *Forst-Ins.* III. Tab III. fig. 10, &c. These species are the largest of this family; the larvæ have twenty-two feet. The larva of *Cimbex lucorum* was not long ago described and figured by SNELLEN VAN VOLLENHOVEN, *Tijdschr. voor nat. Gesch.* I. 1843. Tab. II.

Sub-genera: *Abia* LEACH, *Perga* LEACH, and others of this author. Add sub-genus *Pachylosticta* KLUG, genus *Syzygonia* ejusd. differing from all other *cimbices* in the cells of the wings, but plainly resembling the *Hylotomaæ* (Brazilian species.)

## ORDER VIII. *Lepidoptera.*

Hexapod insects, with four membranous wings, covered with minute coloured scales. Mouth with involute spiral tongue, composed of protracted maxillæ. Metamorphosis complete.

*Butterflies* (*Lepidoptera* L., from λεπὶς *scale*, and πτερὸν, *Glossata* FABR.) The two chief works on the anatomy of this order, that of LYONET and of HEROLD, have been already cited (see above; pp. 247 and 275). To give a list approaching to completeness of the works which treat of the arrangement of butterflies, or illustrate their species by figures, would require too much space for our purpose. We satisfy ourselves therefore with indicating some of the principal sources for the knowledge of this order.

J. C. SEPP, *Beschouwing der wonderen Gods in de minst geachte Schepselen, of Nederlandsche Insekten*, &c. 4to. Amsterdam, 1765, and foll. Of this work, which is still being continued, 6 parts, each of 50 plates, have hitherto appeared.

P. CRAMER, *Uitlandsche Kapellen*, IV. parts, and STOLL'S *Aanhangsel*, 4to. Amsterdam en Utrecht, 1779—1791. (With this may be usefully consulted the academic prize-treatise of H. VERLOREN, *Catalogus systematicus ad* CRAMERUM, Traj. ad Rhen. 1837, 8vo.)

*Systematisches Verzeichniss der Schmetterlinge der Wienergegend herausgegeb. von einigen Lehrern am* K. K. *Theresianum*, Wien. 1776, 4to. (mit 3 col. Taf.)

JAC. HÜBNER, *Sammlung europäischer Schmetterlinge, nebst Fortsetzung* von C. GEYER, gr. 4to. Augsburg, 1805—1841;—by the same, *Geschichte europäischer Schmetterlinge (Raupen, Puppen u. Futterpflanzen)* gr. 4to. ibid. 1806—1841;—by the same, *Sammlung exotischer Schmetterlinge, nebst Fortsetzung von* C. GEYER, III. Bde, gr. 4to. ibid. 1806—1841; and *Zuträge zur Sammlung exotischer Schmetterlinge*, ibid. 1818—1837. (I have not been able to consult these comprehensive and costly works whilst preparing this order).

F. OCHSENHEIMER, *Die Schmetterlinge von Europa, fortgesetzt durch* FR. TREITSCHKE, X. Bde, 8vo. Leipzig, 1807—1835.

BOISDUVAL, *Species général des Lépidoptères*, Tom. I. av. pl. Paris, 1836, 8vo. This excellent work, which makes a part of the well-known *Suites à* BUFFON, published by RORET, appears to be discontinued, to the great injury of science.

The scales, which cover the wings of these insects on both sides, appear to the naked eye as dust, but when seen through the microscope, are arranged in regular rows, like house-tiles[1]. These scales are implanted, by means of little pedicles, in short conical tubules, whose openings are constantly directed to that margin of the wing which is opposite to its base. Each scale consists of two (or perhaps even of three) membranes or layers. On the uppermost membrane lie granules of colouring matter. Elongate, parallel stripes (ribs) run from the base to the free extremity, which has sometimes a smooth margin, and sometimes ends in certain points or lappets. The underside of the scale, which lies next the wing, often presents a play of various colours[2]. When the scales are removed, the wings are whitish and semi-transparent; some butterflies have constantly such patches on the wings where the scales are wanting; in some the wings are almost quite naked, whether because the scales are wanting from the first,

[1] Numerous figures of this are to be seen in the works of microscopists, as in LEEUWENHOECK, *Derde vervolg van Brieven*, 7e Missive, 24 Junij, 1692, bl. 409, fig. 1; see also RŒSEL, *Ins.* I. Tab. II. f. 5, 6, 7, *Pap. Podalirius*, III. Tab. XLIV., *Pap. Iris*, &c.

[2] BERNARD-DESCHAMPS, *Recherches Microscopiques sur l'organisation des ailes dans les Lépidoptères. An. des sc. Nat.*, see. série III. 1835. *Zoologie*, pp. 111—137. Pl. 3, 4.

or because being fixed very loosely, they are lost on the first flight, as has been observed in *Sphinx fuciformis.*

Amongst the oral organs (compare above, p. 249) is seen a small upper-lip, often scarcely visible, which is of a triangular or conical form; the mandibles are small, immoveable, and remote from each other. These parts exist in a *rudimentary* state alone. The principal part of the *organa cibaria* is the *spiral tongue,* formed of two long threads (the *maxillæ*), which are excavated on the inside, elsewhere even, and run out to a fine extremity; when these two plates are laid towards each other, the two half canals form a complete canal in the axis of the tongue. At the base of the maxillæ are placed two very short palps, consisting of one or two, at most of three, joints. The under-lip (*labium*) is triangular and flat, and bears two large palps, which consist of three joints; these palps are covered with hairs, and mount with their points turned upwards on both sides of the tongue, which rolled up in a spiral lies hidden between them, whenever it is not in use. In some nocturnal lepidoptera the tongue is very short and not adapted for sucking.

The antennæ of these insects differ in form, but always consist of numerous joints. The two compound eyes are large; in many species there are in addition two simple eyes present. The three rings of the thorax are always connected immoveably with each other; the middle piece (*mesothorax*) is the largest. The wings are large and not folded; in the females of some species they are reduced to small rudiments, or are entirely wanting. There are five joints in the *tarsus* of all the feet. The abdomen consists of six or seven rings, without sting or borer, as in the preceding order.

The metamorphosis is complete. The larvæ are called *caterpillars* (*erucæ, chenilles, Raupen, rupsen*). The body of caterpillars consists of twelve rings exclusive of the head. There are on each side nine air-slits; for the second, third and last ring are without them. The normal number of feet in caterpillars is eight pairs; the fourth, fifth, tenth and eleventh ring have no feet. On the first three rings three horny feet are placed, which have a conical form, and consist of joints; the last joint has the form of a bent nail. These six feet answer to those of the perfect insect. The remaining ten feet (some species have only eight, six, or four) are membranous and without joints; they disappear in the perfect insect. On the underside they have a flat surface, which the insect is able to expand and contract, and which is surrounded by a coronet of numerous small hooks. The head is horny, and has six simple eyes on each side;

moreover, there may be distinguished in it two short conical antennæ, two strong mandibles, two maxillæ with small palps, and an under-lip, which also has two small palps and terminates in a point, under which the efferent canal of the matter with which the caterpillar prepares its web is situated. This substance is secreted as a fluid by two long, blind, convoluted vessels, which lie at the sides of the intestinal canal. Most caterpillars live on vegetable food, especially leaves, and many are limited to a single species of vegetable. Others, however, eat leather, fur, fat, wax, &c., and these belong especially to the family of the moths. Caterpillars usually change the skin four or five times before turning into pupæ.

The pupæ of scaly-winged insects are quiescent, and move their abdomen alone when they are touched. They are oblong-ovate, and covered with a horny skin (*pupæ obtectæ*, see above, p. 273). The pupæ of day-butterflies are usually not inclosed in a web, but merely attached by some threads at their posterior extremity, and hang freely with the head downward, or are fixed transversely to a branch, or other object, by a transverse band, as if in a hoop. The pupæ of nocturnal butterflies either lie underground in a cavity that is smooth and even within, and lined with web, or they are inclosed in a cocoon (*folliculus*), which is fastened to a branch, or to a wall. The web is frequently silken, sometimes very closely woven, sometimes loosely; sometimes it consists in part of finely gnawed fibres of wood interwoven with the threads of web, or of other foreign objects intermixed with the web, crumbs of earth, morsels of leaves, &c. These pupæ have commonly a brown or black colour.

From the pupa of many species, especially of day-butterflies, the perfect insect proceeds after the lapse of a few days. Of such species there are ordinarily two generations in a year. Of other species, however, the caterpillar or the pupa remains through the winter, and then the perfect insect usually appears only once in the year, in spring or in summer. Eggs that are laid in autumn are mostly hatched in the following spring.

The intestinal canal of caterpillars is straight, and consists in great measure of a wide cylindrical stomach. There are four very long vessels for secretion of urine. The perfect insect has a narrow œsophagus with a lateral expansion or crop (the so-called sucking bladder, see above, p. 310); the stomach has become shorter, the rest of the intestinal canal longer. Lepidopterous insects in the perfect state of butterflies either take no food at all, or suck the

sap of flowers; they lick this up by means of their maxillæ, prolonged into a tongue.

This order is very numerous in species. Amongst these are many which attract our eye by their brilliant colours, or the beautiful design of the spots or streaks on the wings. It is as though nature had given such large wings to butterflies in order to secure a wider space for her pencil.

Family XXV. *Nocturna.* Antennæ setaceous or pectinate. Wings horizontal for the most part or deflected, guarded by a retinaculum, with few exceptions. Posterior tibiæ with double internal spine.

*Nocturnal Lepidoptera, Moths.* The species of this and of the following family are distinguished by the so-called "*retinaculum*, which they mostly possess. This part consists of a horny highly-elastic hair, or of a little bundle of two or more hairs, which arise on the anterior margin of the hind-wings close to their insertion. A little flat ring on the under-surface of the fore-wing allows it a passage, and thus both wings are connected, and similarly pressed forwards and backwards, and in flight form only a single surface[1]. Almost all these moths fly by night alone, or after sunset. The females of some species are wingless, or have only minute rudiments of wings (as *Phalæna brumata, Bombyx antiqua,* &c.) The form of the larva is various, and they have from 10 to 16 feet. Most of them make themselves a web, in which they change to pupæ.

This family in the system of LINNÆUS forms only a single genus, which he names *Phalæna.*

*Pterophorus* GEOFFR., FABR. Four wings or two posterior cloven, with fringed digitations. Antennæ long, setaceous. Body slender. Feet elongate.

Sub-genus *Pterophorus* LATR. Labial palps small.

Sp. *Pterophorus pentadactylus, Phalæna (Alucita) pentadactyla* L. RŒSEL, *Ins.* I. Class IV. *Pap. nocturn.* Tab. V. &c. The caterpillars of this species have sixteen feet, are broad and hairy, and change without spinning themselves in; the pupæ hang by threads, like those of day-butterflies. The perfect insect sits with outspread wings, and reminds us of *Tipula.*

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[1] I have treated specially of this part, and figured it in the *Natuurk Bijdragen,* by H. C. VAN HALL, W. VROLIK and G. J. MULDER, II. 1827, bl. 273—284.

Sub-genus *Orneodes* LATR. Labial palps longer than head, with second joint very scaly, the last somewhat naked, erect.

Sp. *Pterophorus hexadactylus, Phalæna (Alucita) hexadactyla* L., RÉAUMUR, *Ins.* I. Pl. 19, figs. 19—21, DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 43, fig. 8. The sixteen-footed naked caterpillar feeds on the blossoms of *Kamperfolia (Lonicera)*, and spins itself up when about to change into a pupa. The perfect insect has each wing divided into six slips, and keeps the wings when at rest deflected.

*Tinea* FABR. (and *Alucita* ejusd.) Anterior wings narrow, or horizontal, incumbent, or convolute round the body or deflected and erect backwards. Labial palps erect, maxillary palps often distinct. Antennæ setaceous.

A. *Labial palps short, pilose. Antennæ, especially of males, mostly very long, approximate. Eyes subcontiguous posteriorly.*

Sub-genus *Adela* LATR. (*Alucita* FABR. in part).

Sp. *Tinea Degeerella* L., DE GEER, *Ins.* I. Pl. 32, fig. 13; GUÉRIN, *Iconogr. Ins.* Pl. 91, fig. 7; FISCHER'S *Abbildungen zur Microlepidopterologie*, 1834, Tab. 66, 67, figs. *a—c*; P. LYONET, *Ouvrage posthume*, Pl. 19, figs. 17—25; wings gold brown with a yellow band on the fore-wing, which is margined with violet. Expanded wings about 8‴, antennæ of male 14‴ long. In the pupa the antennæ have special cases that project behind the body.

B. *Labial palps moderate, very distinct. Eyes and antennæ remote.*

*a) Tongue distinct, elongate.*

Sub-genera *Œcophora* LATR., *Yponomeuta* LATR., *Ilithyia* LATR., *Ornix* TREITSCHKE.

Sp. *Tinea evonymella* L. (*Yponomeuta evon.*), RŒSEL, *Ins.* I. *Pap. nocturn.* Cl. IV. Tab. VIII; the caterpillars live socially in a web, as do those of *Yponomeuta cognatella*, RŒS. l. l. Tab. VII. SEPP VI. Tab. XXVII, that live on thorn-bushes and fruit-trees, and also, what is often confounded with it, *Tin. padella* L., SEPP V. Tab. XXXII. whose caterpillar lives on willow-trees.

*b) Tongue very short. (Crest on the head of hairs or scales.)*

Sub-genus *Tinea* LATR.

Sp. *Tinea pellionella* L., RŒSEL, *Ins.* I. *Pap. nocturn.* Cl. IV. Tab. XVII. *the fur-moth;* shining brown upper wings with a black spot; it shews itself in the spring; according to TREITSCHKE there are two generations in a year; —*Tinea granella* L., RŒSEL, ibid. Tab. XII. &c.

*Crambus* FABR. Fore-wings narrow, much longer than broad. Maxillary or upper palps very distinct, porrect above the base of

labial palps, covered with scales or hairs. Antennæ mostly simple. (Caterpillars with sixteen feet).

*a*) Tongue very short, scarcely distinct.

Sub-genus *Phycis* FABR. (*Phycis* and *Euplocamus* LATR., with antennæ of males pectinate).

*b*) Tongue distinct.

Sub-genera *Crambus* (*Chilo* SOMMER), *Alucita* LATR., *Galleria* FABR.

Sp. *Galleria cerella, Tinea mellonella* L., RŒSEL, *Ins.* III. *Pap. noct.* Cl. IV. Tab. XLI. SEPP V. Tab. XLVI; with grey wings, the upper wings more brownish, dark-spotted and excised on the outer margin in the male, in the female obtuse. The caterpillar of this species lives in the hives of bees, always protected and concealed under spun threads. The metamorphosis occurs within the hive. The moths come from the pupa in the spring. These enemies of bees were known to the ancients; VIRGIL calls them *dirum tineæ genus* (*Georgic.* Lib. IV. 246; comp. PLINIUS, *Hist. nat.* Lib. XI. cap. XIX.)

*Botys* LATR. (and *Hydrocampe* ejusd.) Fore-wings triangular, forming with the body a sub-horizontal triangle when the insect is at rest. Four exsert palps. Tongue conspicuous. Antennæ setaceous.

Sp. *Botys verticalis, Phalæna* (*Pyralis*) *verticalis* L., RŒSEL, *Ins.* I. *Pap. noct.* Cl. IV. Tab. IV. SEPP V. Tab. XXIV. &c.

*Aglossa* LATR. Tongue inconspicuous. Habit and characters of the preceding genus. (Species of genus *Pyralis* TREITSCHKE, *Crambus* FABR.)

Sp. *Aglossa pinguinalis, Phalæna* (*Pyralis*) *pinguinalis* L., DE GEER, *Ins.* II. Pl. VI. figs. 4—12, SEPP V. Tab. XX. &c.

*Tortrix* TREITSCHKE, *Pyralis* FABR., LATR. (*Phalæna Tortrix* L.) Wing of insect at rest representing the form of a roof much flattened or subhorizontal, and with the body forming a triangle, short, broad, anteriorily arcuate outwards, the external margin of the fore-wings being produced to the base. Maxillary palps either none or short, not exsert; labial palps with second joint thick, hirsute, in some short, in others longer and in the anterior part of the head, produced like a beak. (Caterpillars with sixteen feet.)

*Leaf-rollers.* These have been thus named because the caterpillars of many species roll up and spin together the leaves on which they feed. Some tie up young buds and blossoms with their web; others

again live in fruits, as *Tinea pomonella* L. (the genus *Carpocapsa* TREITSCHKE).

Sub-genera *Cochylis, Teras, Carpocapsa, Halias, Pædisca,* TREITSCHKE and others, on which see *Schmetterlinge von Europa,* Tom. VIII., and WESTWOOD, *Generic. Synopsis,* pp. 106—110.

Sp. *Tortrix chlorana* L., (*Halias* TREITSCHKE) DUMÉR. *Consid. gén. s. l. Ins.* Pl. 53, fig. 6, SEPP VI. Tab. XII.;—*Tortrix vitana, Tortrix pelleriana, System. Verz. d. Schmett. d. Wienergeg.* p. 126, *Pyrale de la Vigne* BOSC. This species, which causes great injury to vines, and so, in France especially, from time to time produces serious damage, is the chief subject of an extensive and excellent work of AUDOUIN, *Hist. des Insectes nuisibles à la Vigne,* Paris, 1842, 4to.

*Tortrix pomana, Tinea pomonella* L., RŒSEL, *Ins.* I. *Pap. noct.* Cl. IV. Tab. XIII. SEPP VI. Tab. X. &c.

*Herminia* LATR., *Hypena* SCHRANK. Wings triangular, subhorizontal, deflected, forming with the body a triangle when the insect is seated; the anterior sub-falcate at the apex, with posterior margin convex. Labial palps longer than head, compressed, with last joint recurved. Ocelli two. Antennæ of males ciliated or sub-pectinate. (Caterpillars with fourteen feet).

Sp. *Herminia proboscidalis, Phalæna* (*Pyralis*) *proboscidalis* L., KLEEMANN, *Beyträge zu* RŒSEL'S *Ins.* Tab. XXXII. SEPP II. 5e Stuk, Tab. II. the brown snout-moth; on the stinging-nettle;—*Herm. rostralis, Phal.* (*Pyralis*) *rostralis* L., RŒSEL, *Ins.* I. *Pap. noct.* Cl. IV. Tab. VI.; on the hop, also on stinging-nettles, &c. The caterpillars of these species have no feet on the sixth ring of the body; when touched they let themselves fall to the ground, and leap like fishes drawn out of water.

*Note.*—Genus *Hyblæa* FABR. is joined with *Herminia* by LATREILLE; it contains exotic species, which whether they be all rightly placed here, appears to me very doubtful. *Hyblæa liturata* FABR. from the Cape of Good Hope, *Naturforsch.* XXIX. Tab. IV. fig. 14, appears to agree entirely with *Herminia;* here also are to be referred *Phalænæ Servia* and *Sergilia* CRAM.

On genus *Hyblæa* comp. ESPER in *Naturforscher,* XXIX. 1802, pp. 191—206, Tab. IV.

*Phalæna* FABR. (*Phalæna geometræ* L.) Wings broad, mostly patent when the insect is at rest, with anterior only partly covering posterior, sometimes erect. Antennæ elongate, towards the extremity attenuated, setaceous, or in males pectinate. Labial palps moderate. Ocelli none. Body attenuated. Most of the caterpillars

with only ten feet, the rest with twelve, always with anal feet. Pupa inclosed in a thin follicle.

The genus *Phalæna* or *Geometra* is principally characterised by the caterpillars; since these have no feet in the middle of the body they move in creeping, as leeches do, by flexion and extension of the body. Hence these caterpillars are named *surveyors* or *span-caterpillars* (*erucæ geometricæ, chenilles arpenteuses, Spanner.*)

Comp. on this genus TREITSCHKE especially, *Die Schmetterlingen von Europa*, of which the entire sixth part (Leipz. 1827, 1828) is set apart for treating of the numerous European species of this genus; and further HERRICH-SCHÆFFER, *Uebersicht der Spanner*, in his continuation of PANZER, *Ins. Deutschl.* Heft 165, 176, 179.

LINNÆUS has made a subdivision according to the antennæ; where they are pectinate he gives to the specific name the termination *-aria* (as *piniaria*), when they are setaceous that of *-ata* (as *grossulariata*[1]). The characteristic of pectinate antennæ, however, besides that it is proper to the male alone, occasionally separates naturally allied species. As little can the separation of these species, which have wingless females, of which LATREILLE forms his sub-genus *Hybernia*, be commended.

*a*) Caterpillars with twelve feet.

*Ellopia* TREITSCHKE. (Antennæ in males pectinate.)

Sp. *Phalæna margaritaria* FAB., *Phalæna margaritata* L. fem., SEPP, *Nederl. Ins.* II. *Nachtvl.* II. Bende 1 Gezin, Tab. III., PANZ. *Deutschl. Ins.* Heft 41, Tab. 23, Heft 63, Tab. 23; light-green wings, the fore with two white bands, the hinder with one only, which is a continuation of the most external of the fore-wing. Amongst the *Noctuæ* also some species occur with twelve-footed caterpillars, which however are not spanners.

*b*) Caterpillars with ten feet.

*Ennomos, Acœna, Geometra, Aspilates, Crocallis, Gnophos, Boarmia, Amphidasis, Psodos, Fidonia, Chesias, Cabera, Acidalia, Larentia, Cidaria, Zerene, Minoe, Idœa* TREITSCHKE (a name to be rejected since already given by FABRICIUS to a genus of the Diurnals). Comp. on other genera, here omitted, WESTWOOD, *Generic. Synops.* pp. 98—104.

[*Note.*—The numerous species of *Phalænæ* are distinguished by variety of form, and often present an analogy truly wonderful with other genera

[1] Here we have an instance of the happy *mnemotechnic* of which LINNÆUS in all his writings made such rational use. The distinction however given by him is not in every instance well-founded; *Phal. sambucaria*, for example, ought properly to be called *sambucata*.

of *Lepidoptera*, so that there may be observed, principally among the exotic genera, some that recall the genus *Pieris*, others *Papiliones* (or *Equites*), not in habit alone, but also in colour. Perhaps a parallel series is formed by the *Phalænæ*, comparable with most of the genera of diurnal *Lepidoptera*. Other exotic *Phalænæ* approach more nearly to the genus *Urania*, but yet amongst European species *Phalæna sambucaria* presents an analogy with it.]

Sp. *Phalæna betularia* L., *Amphidasis betularia* TREITSCHKE, SEPP II. 4e Stuk, Tab. XXI. *the black-sprinkled moth*, PANZ. *Deutschl. Ins.* Heft 31, Tab. 24; with long, small, round wings, outspread, 2″ broad, length of body usually 9‴, the abdomen thicker and more unwieldy than in most species of this division; wings and body yellowish-white, with many black spots and points;—*Phal. sambucaria* L., *Acæna sambucaria* TREITSCHKE, *Ourapteryx sambucaria* LEACH, RŒSEL, *Ins.* I. *Pap. Nocturn.* Cl. III. Tab. VI. SEPP, *Nederl. Ins.* I. 6e Stuk, Tab. I., one of the largest European species, but of a totally different form, with broad wings, the anterior falcate at the apex, the posterior excised at the margin with obtuse angles, of which angles the third is produced into a short tail; the general colour pale sulphur-yellow, with two light brown bands on the fore-wings, and one similar on the hind-wings, which is a continuation of the innermost of the former. The eggs are prettily ribbed; the caterpillar is a true spanner, of a brown colour, resembling a dead twig. *Phal. defoliaria* L., *Fidonia defoliaria* TREITSCHKE, RŒSEL III. Tab. XIV. (the metamorphosis and the wingless female), Tab. XL. fig. 6 (the perfect male), SEPP, *Nederl. Ins.* II. 6 Stuk, Tab. VI. RATZEBURG, *Forst-Ins.* III. Tab. XI. fig. 5, &c.

*Platypteryx* LESPEYRES, OCHSENH., *Drepana* SCHRANK. Wings, the insect at rest, patent, anterior broad, in some rotundate, in most falcate. Palps short. Antennæ in males pectinate, in females setaceous or serrate or very shortly pectinate. Ocelli none. Caterpillars with fourteen feet, terminated by apex acute, erect, the anal feet wanting.

Sp. *Platypteryx falcula*, *Phal.* (*Geometra*) *falcataria* L., LYONET, *Ouvrage posth.* Pl. 35, figs. 6—10; *Platypt. hamula*, *Phal. falcata* FABR., SEPP, *Nederl. Ins.* II. 4e Stuk, Tab. XVI. The *one-tailed caterpillars* resemble in some degree in miniature the two-tailed caterpillars (*Bombyx vinula*, *furcula*;) whence some writers have placed them with the *Bombyces* (*Verzeichniss der Schmetter. der Wiener gegend*, p. 64, HÜBNER, LATREILLE); LINNÆUS and FABRICIUS, giving their attention exclusively to the perfect insect, placed the species known to them amongst the *Phalænæ geometræ*, with which indeed they have a greater affinity. The point in which the body of the caterpillar terminates behind forms a supernumerary segment (a thirteenth ring), which represents the two hind-feet that are wanting.

*Noctua* FABR. Tongue distinct. Palps in most moderate, with third terminal joint more slender than the preceding or small.

Antennæ mostly setaceous, in males of some species only pectinate or ciliate. Ocelli, with a few exceptions, two. Wings apt for flight, the anterior mostly triangular, deflected or incumbent. Thorax large, very often crested. Abdomen elongato-conical. Larvæ solitary, mostly naked or seldom pilose, never without anal feet, most with sixteen, some with only twelve feet. Pupa inclosed in a follicle often lax.

*a) Last joint of palps shorter than second, scaly.*

* *Caterpillars with twelve feet.*

*Euclidia* OCHSENH. Palps short. Head small. Body slender, with thorax not crested. (Anterior wings variegated with irregular brown markings.)

Sp. *Noctua Mi* L., SEPP, *Nederl. Ins.* II. 5e Stuk, Tab. I., LYONET, *Ouvr. posthume*, Pl. 32, figs. 10—17; the caterpillar lives on different species of grass, on clover, &c., and spins itself up between the leaves or in moss when about to change into a pupa.

*Plusia* OCHSENH. Palps long. Thorax crested. (The fore-wings often with spots or marks that shine with metallic splendour.)

*Noctua gamma* L., RŒSEL, *Ins.* I., *Pap. nocturn.* Cl. III. Tab. V. SEPP, *Nederl. Ins.* I. 5e Stuk, Tab. I. f. 1—6; *the gamma-moth;* body grey, fore-wings reddish-grey with many stripes, in the middle and at the base dark-brown, with a yellowish shining spot resembling the Greek letter γ, the hind-wings yellowish-grey, with a blackish broad border; length of the body 3‴; breadth of upper wings expanded 15‴. The caterpillar of this species sometimes occasions much damage to flax, hemp, cole-seed, peas, pulse, and all sorts of potherbs; a visitation which afflicted different districts of France in 1735, and the province of Groningen in East-Prussia in 1823: see J. JACOBSON *de Phal. noctua gamma Diss.* Regiomonti, 1829, 8vo, and H. C. VAN HALL, *Gesch. van de verwoestingen door de rupsen in het jaar* 1829 *aangerigt.* Groningen, 1829, 8vo.

** *Caterpillars with sixteen feet.*

Sub-genera: *Brephos* OCHSENH., *Catocala* SCHRANK, OCHSENH., *Ophiusa* OCHSENH., *Anarta* OCHSENH., *Cucullia* SCHRANK, OCHSENH.

*Noctua* nob.

(*Xylina, Cerastis, Cosmia* HUEBN., *Xanthia* HUEBN., *Gortyna, Nonagria, Leucania, Simyra, Caradrina, Orthosia, Mythimna, Calpe, Thyatira, Mamestra, Apamea, Trachea, Polia* OCHSENH., *Miselia* HUEBN., OCHSENH., *Hadena* SCHRANK, *Mania* TREITSCHKE, *Amphipyra, Triphæna, Graphiphora, Agrostis* OCHSENH.)

*Episema* Ochsenh., *Cymatophora* Treitschke (*Tethea* Ochsenh.), *Bryophila* Treitschke (*Pœcilia* Schrank, Ochsenh.), *Diphthera* Hueen., Ochsenh., *Acronycta* Ochsenh.

Comp. *Encycl. méth., Hist. nat., Ins.* Tom. viii. 1811, pp. 218—360 (article *Noctuelle*), Treitschke, *Schmetterlinge von Europa*, Vter Bd. 1825, 1826, Westwood, *Generic Synopsis*, pp. 93—98, &c.

Sp. *Noctua nupta* L., Sepp, *Nederl. Ins.* i. 4e Stuk, Tab. vii., Lyonet *Ouvr. posth.* Pl. 25; body 1″ 2‴ long, points of fore-wings in flight distant 2″ 9‴ or more from each other; fore-wings above grey, passing into bluish-green, with dark-brown flamed stripes, beneath white, with three black bands; under-wings above carmine-red, with two broad black bands, which are present on the under-side also, but on a white ground, which towards the inner margin passes into red. The caterpillar lives on the willow. A still larger, and with us a rarer species, has on the under-wing a blue band on a black ground: *Noctua fraxini* L., Roesel, *Ins.* iv. Tab. 28, fig. 1, Sepp, *Nederl. Ins.* i. 4e St. Tab. xviii—xx. —*Noctua pronuba* L., *Triphœna pronuba* Treitschke, Roesel, *Ins.* iv. Tab. 32, fig. 6, Verhuell in Sepp, *Nederl. Ins.* vi. Tab. 34, figs. 7, 9; the upper-wings brown, cinnamon-coloured of different shades; the under-wings yellow, with black band close along the margin; breadth of wings in flight 2″, length of body about 10‴. A very common species, which in the middle of summer is often seen in houses, being attracted towards evening by the light. A lighter prothorax distinguishes it from *Noctua (Triphœna) innuba* Treitschke, where the thorax is of a single colour; this last has the fore-wings less flammate, often almost entirely of one colour, and ordinarily a light coffee-colour (*café au lait*); Roesel, *ibid.* figs. 1, 2, 4, 5, Sepp Tab. 33, fig. 6, Tab. 34, figs. 8, 10. Linnæus united both species under his *Noctua pronuba*, and perhaps they are only varieties.—*Noctua piniperda, Trachea piniperda* Treitschke, Panzer, *Deutschl. Ins.* Heft 83, Tab. 24, (*Bombyx spreta* Fabr., and *Noctua flammea*, ejusd.,) Sepp, *Nederl. Ins.* iii. Tab. 34, Ratzeburg, *Forst-Ins.* ii. Tab. x. fig. 4; half an inch long, flight 15 to 16‴ broad, upper-wings brown-red and grey, with two whitish spots in the middle, hind-wings dark-grey, under-side of wings single shade of grey, shining; the caterpillar green and white striped longitudinally. This caterpillar occasionally causes great mischief in forests; see Loschge, *Naturgesch. der Forb-oder Kiefferraupe, Naturforscher*, xxi. 1785, s. 27—65, Tab. iii; as in Holland (particularly in the province of Gelderland) in 1808, and especially in 1844; comp. hereon A. Brants in the *Vaderl. Letteroefeningen*, 1844, *Mengelwerk*, bl. 525—536; and on the destruction in the pine-forests of the province of Utrecht, H. Verloren in the *Alg. Kunst-en Letter-bode*, 1846, Nos. 13, 15, and 1847, No. 9.

*b) Last joint of palps equal to second or longer than it, slender, subnaked.*

*Erebus* Latr. (*Thysania* Dalm.)

Sp. *Noctua Strix* L., Fabr., *Noctua Agrippina* Cramer, *Uitl. kap.* i. Tab. 87, 88, fig. A; Cuvier *R. ani. éd. ill., Ins.* Pl. 154, from Surinam. The

upper surface of wings white, with black lines forming many angles and curves, the under surface brown-grey with white spots. This species is one of the largest in this order; the body is two inches long, but the fore-wings, which are very long, surpass those of all the rest in breadth of flight, for the points are distant from each other more than nine inches. Another species also from South America, *Noctua odora* CRAMER, II. Tab. 169. f. A, B, was placed erroneously by LINNÆUS amongst the *Attaci* (*Bombyx*); it is smaller, brown-coloured, and has an eye-shaped spot on the fore-wings.

*Lithosia* FABR. Tongue distinct, long, spiral. Labial palps cylindrical, shorter than head, with third joint shorter than the preceding, or coalesced with the second. Antennæ moderate, setaceous, in males ciliated or subpectinate. Ocelli none. Anterior wings narrow, horizontally incumbent. Caterpillars solitary, with sixteen feet.

Sp. *Lithosia quadra, Phalæna* (*Noctua*) *quadra* L., RŒSEL, *Ins.* I., *Pap. noct.* Cl. II. Tab. XVII.; SEPP, *Nederl. Ins.* III. 4e Stuk, Tab. VI.; DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 42, fig. 1 bis; wings outspread 2", yellow, the upper wings in the male grey-yellow, in the female yellow, with two steel-blue or black spots; the feet blue.

Sub-genus: *Nudaria* HAWORTH, STEPH. (spec. of *Lithosia* OCHSENH., species of *Callimorpha* LATR.)

Sp. *Lithos. mundana* OCHSENH., *Phalæna mundana* L., HOFFMANN. *Naturforscher*, XXVIII. 1799, Tab. I. figs. 1—5.

*Euprepia* OCHSENH. (*Arctia* SCHRANK, *Chelonia* GODART, BOISDUV.) Tongue distinct. Antennæ in males ciliated or pectinate. Ocelli two. Wings deflected, variegated with colours often lively, anterior triangular, posterior furnished with retinaculum. Larvæ with sixteen feet, mostly hirsute with dense hairs.

*Callimorpha* LATR. (in part). Tongue elongate. Antennæ simple, ciliated in males alone.

(Sub-genera: *Emydia, Euchelia,* and *Callimorpha* BOISDUV., species of *Euprepia* and *Lithosia* OCHSENH.)

Sp. *Euprepia Jacobææ, Phal.* (*Noct.*) *Jacobææ* L., RŒSEL, *Ins.* I., *Pap. noct.* Cl. II. Tab. XLIX.; SEPP, *Nederl. Ins.* 4e Stuk, Tab. XI; the upper wings dark-bluish grey with two carmine-red stripes along the anterior and inner margin, and two round spots of the same colour; the hind-wings carmine-red with a narrow black border.

*Arctia* SCHRANK. Tongue short. Antennæ, in males at least, bipectinate. Abdomen thick.

Sp. *Euprepia caja, Phal. (Bombyx) caja* L., RŒSEL, *Ins.* I., *Pap. noct.* Cl. II. Tab. I.; SEPP, *Nederl. Ins.* I. 4e Stuk, Tab. II; wings outspread 2½″—3″ broad; fore-wings brown marbled with white, hind-wings vermilion-red with blue-black round spots. Here belong many other species named by LINNÆUS *Bombyces nobiles. Syst. nat. ed.* XII. I. p. 819.

*Psyche* SCHRANK, LATR., OCHSENH. Tongue obsolete. Antennæ in males pectinate. Ocelli two in many. Wings rarely scaly, subpellucid, in females none. Caterpillars inclosed in a tube or sac of conglutinated fragments of leaves and stalks.

Sub-genus: *Oiketicus* GUILDING.

See *Linn. Trans.* XV. 1827, pp. 371—377. The apterous female does not leave the follicle, and is there impregnated by the male.

*Limacodes* LATR., *Heterogenea* KNOCH, TREITSCHKE. Palps very short. Tongue obsolete. Antennæ setaceous. Ocelli none. Wings opaque; females winged as well as males. Caterpillars broad, resembling slugs, creeping, with six horny feet very short, membranous feet none, tubercles of the skin supplying their place.

Sp. *Limacodes Testudo, Hepialus Testudo* FABR., SEPP, *Nederl. Ins.* II. 4e Stuk, Tab. IV. on oaks; *Heterogenea asellana* TREITSCHKE, *Hepialus asellus* FABR., KNOCH, *Beiträge zur Insectengesch.* III. 1783, Tab. III.

*Sericaria* LATR. (*Liparis, Pygœra, Endromis* OCHSENH., *Orgyia* OCHSENH., LATR.). Tongue short or obsolete. Antennæ in males or in both sexes pectinate. Ocelli none. Wings opaque, deflected, posterior guarded by a retinaculum. Larvæ with sixteen feet.

Sp. *Sericaria dispar, Phal. (Bombyx) dispar* L., RŒSEL, *Ins.* I., *Pap. noct.* Cl. II. Tab. III.; RATZEBURG, *Forst-Ins.* II. Tab. V. fig. 1. This species is very common, and sometimes very injurious to trees. The brown caterpillar with long bundles of hair has on each side of the body a row of eleven round spots, of which the first five are bluish-white, the following red. The female moths are a dirty white, with black bands on the upper wings, and very sluggish; the male, much smaller, has brown wings. In some species the females have merely short rudimentary wings (*Orgyia* OCHSENH.), *Sericaria antiqua, Phal. (Bomb.) antiqua* L., RŒSEL, *Ins.* I. *Pap. nocturn.* Cl. II. Tab. XXXIX. Tom. III. Tab. XIII. &c.

*Notodonta* OCHSENH., LATR.

Sp. *Notodonta ziczac, Phal. (Bomb.) ziczac* L., RŒSEL, *Ins.* I., *Pap. nocturn.* Cl. II. Tab. XX.; SEPP, *Nederl. Ins.* I. 4e Stuk, Tab. XII. &c.

*Cerura* SCHRANK, LATR., *Harpyia* OCHSENH. Tongue very short or obsolete. Antennæ in males or in both sexes bipectinate,

with teeth deflected, hairy, towards the extremity of antennæ shorter or none. Ocelli none. Wings deflected, somewhat thin or sub-pellucid, beneath pilose, the posterior bridled by retinaculum. Body hirsute. Larvæ smooth, with fourteen feet, and two conical elongate tubercles in place of anal feet.

Sp. *Cerura vinula, Phal.* (*Bombyx*) *vinula* L., RŒSEL, *Ins.* I., *Pap. nocturn.* Cl. II. Tab. XIX.; SEPP, *Nederl. Ins.* I. 4e Stuk, Tab. V.; LYONET, *Ouvr. posth.* Pl. 34, figs. 1—15. *Puss Moth.*

*Bombyx* nob. (*Bombyx* and *Lasiocampa* SCHRANK, LATR., *Gastropacha* OCHSENH.) Tongue short or obsolete. Ocelli none. Antennæ in both sexes bipectinate. Wings deflected, reversed, the external margin of posterior produced beyond the margin of the anterior; retinaculum none. Body thick.

Sp. *Bombyx mori, Phal.* (*Bombyx*) *mori* L., RŒSEL, *Ins.* III. Tab. VII—IX. *the silk-worm;* the caterpillar is whitish-grey, smooth, and has a small horn at the hinder extremity on the back; when fully grown, it reaches quite 3″ in length, and feeds on mulberry-leaves; the moth is dirty-white, and has on the fore-wings inconspicuous light brown stripes. The pupa is brown, elongate, oval and obtuse; it lies inclosed in a close web (cocoon) from which silk is procured. This species was first introduced into Europe in the time of the Emperor JUSTINIANUS.

*Bombyx potatoria, Phal.* (*Bomb.*) *potatoria* L., RŒSEL, *Ins.* I., *Pap. nocturn.* Cl. II. Tab. II.; SEPP, *Nederl. Ins.* I. 4e Stuk, Tab. VIII. *Drinker moth.*

*Saturnia* SCHRANK, LATR. (*Saturnia* and *Aglia* OCHSENH.) Tongue obsolete. Antennæ in males doubly pectinate, with two teeth directed upwards and two downwards in every joint. Ocelli none. Wings when at rest expanded, the inferior without retinaculum, the disc adorned with ocellar spot, which is most frequently naked in the middle, pellucid.

Sp. *Saturnia carpini,* OCHSENH., *Phal.* (*Bombyx*) *pavonia a) minor* L., RŒSEL, I. *Pap. noct.* Cl. II. Tabs. IV. V.; SEPP, *Nederl. Ins.* I. 4e Stuk, Tab. X. XI. Amongst the exotic species may be noted the East Indian *Saturnia atlas* (CRAMER, *Uitl. Kap.* I. Tab. 9, fig. A. Tab. 381, fig. C. Tab. 382, fig. A.) on account of its size and beauty. All the species of this genus are amongst the larger *Lepidoptera.*

*Cossus* FABR. (*Cossus* LATR., *Zeuzera* ejusd.) Tongue obsolete. Antennæ denticulate or pectinate, in some towards the extremity setaceous, simple. Ocelli none. Head small, deflected. Thorax gibbous, large. Female with ovipositor exsert. Wings deflected,

elongate, rotundate, inferior furnished with retinaculum. Larvæ smooth, with sixteen feet, living in wood.

Sp. *Cossus ligniperda, Phal.* (*Bombyx*) *Cossus* L.; SEPP, *Nederl. Ins.* III. Tab. XLIII. XLIV; DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 45, fig. 5; RATZEBURG, *Forst-Ins.* II. Tab. III. fig. 1. The expanded wings are more than 3″ broad; the colour of the wings is ash-grey, with black interrupted stripes that meet reticulately. The caterpillar reaches a length of three inches, and is red-brown on the back; it lives more than two years before changing into pupa, and infests not willows alone, but other trees also. It is this species which was investigated by LYONET in his unrivalled *Traité anat. de la Chenille*, and is on that account so generally known. See also his *Recherches sur l'Anat. et les Métamorphoses des Insectes*, edited by DE HAAN, pp. 369—546, Pl. 39—54 (on this insect in the state of pupa and moth).

*Zeuzera* LATR. Antennæ in males pectinate at base, setaceous at apex, in females serrate.

*Stygia* DRAPARN. (Species of *Chimæra* OCHSENH.)

*Hepialus* FABR., *Hepiolus* ILLIG. Tongue obsolete. Antennæ very short (shorter than thorax), filiform or subserrate. Ocelli none. Wings deflected, lanceolate, posterior mostly without retinaculum. Larvæ smooth, with sixteen feet, subterranean, rhizophagous.

Sp. *Hepialus humuli, Phal.* (*Noctua*) *humuli* L., PANZER, *Deutschl. Ins.* Heft 70, Tab. 23, 24;—*Hepial. lupulinus, Phal.* (*Noctua*) *lupulina* L.; PANZER, *Deutschl. Ins.* Heft 94, Tab. 23, 24; GUÉRIN, *Iconogr. Ins.* Pl. 85, fig. 1, &c.

Family XXVI. *Crepuscularia.* Wings subhorizontal or deflected, bridled in almost all, the posterior furnished with retinaculum. Antennæ prismatico-clavate or fusiform, simple or serrate, in few pectinate. Tongue distinct, in some very long. Posterior tibiæ with double internal spine. Caterpillars with sixteen feet, sometimes naked, furnished posteriorly with dorsal horn, sometimes pilose or hirsute. Pupa smooth, in some folliculated, in most buried beneath the earth. Flight of imago matutine and vespertine.

*Evening-moths, Twilight-moths, Crepuscular moths.* This family consists for the most part of the Linnæan genus *Sphinx*.

I. *Anterior wings elongate, narrow, posterior small, much smaller than anterior.*

*Sesia* FABR. (exclusive of species). Wings subcylindrical, incrassated before the apex, terminated by a fasciculus of rigid setæ. Ocelli two. Wings hyaline.

Comp. J. R. LASPEYRES, *Sesiæ Europææ iconib. et descriptionibus illustratæ.* Berolini, 1801, 4to.

*Thyris* HOFFMANNSEGG.

The larvæ of these two genera live in the wood or the pith of plants.

*Zygæna* FABR., *Anthrocera* SCOPOLI. Antennæ in both sexes simple, flexuoso-clavate, with smooth apex. Ocelli two. Tongue long, spiral. Wings deflected, lively coloured, longer than body, narrow.

Sp. *Zygena filipendulæ, Sphinx filipendulæ* L., RŒSEL, *Ins.* I., *Pap. nocturn.* Cl. II. Tab. LVII.; SEPP, *Nederl. Ins.* I. 4e Stuk, Tab. XXII: the body and antennæ are blackish-green, the upper wings dark-bluish green, shining, with six carmine-red spots; the under-wings carmine-red with a bluish-black edge. The caterpillar lives on clover, &c. is yellow, thick, with short hairs, without horn on the back, and makes a compact but thin web on the stem of the plant when about to change into a pupa. This genus approaches *Euprepia* in the preceding family.

*Syntomis* ILLIG.

Comp. BOISDUVAL, *Essai sur une Monographie des Zygénides,* Paris 1829, 8vo, av. pl. color.

*Glaucopis* FABR. (and *Procris* ejusd.) Antennæ in males or in both sexes bipectinate. Ocelli two.

*a*) Tongue obsolete.

*Aglaope* LATR. (spec. of *Atychia* OCHSENH.)

*b*) Tongue distinct.

Sub-genera: *Glaucopis* FABR. (With antennæ in both sexes bipectinate), *Procris* FABR. (*Ino* LEACH), *Atychia* HOFFMANNS., LATR.

Sp. *Sphinx Statices* L., SEPP, *Nederl. Ins.* IV. Tab. 40; PANZER, *Deutschl. Ins.* Heft 32, Tab. 24.

*Sphinx* L. (in part). Antennæ clavato-prismatic, incrassated before the apex, mostly with uncus or short seta, recurved and ciliated at the extremity. Labial palps broad, compressed, with third joint indistinct. Ocelli none.

*Smerinthus* LATR. Tongue very short. Antennæ serrated. Anterior wings angulate.

Sp. *Sphinx Tiliæ* L., *Sphinx Populi* L., *Sphinx ocellata* L. Comp. SEPP, *Nederl. Ins.*

*Sphinx* LATR. Tongue distinct, sometimes very long. Anterior wings in some angulate, in others quite entire, rotundate.

*a) Tongue shorter.* (*Acherontia* OCHSENH., *Brachyglossa* BOISDUV.)

Sp. *Sphinx Atropos*, RŒSEL, *Ins.* III. Tab. I. II.; SEPP, *Nederl. Ins.* III. Tab. XXII—XXVIII.; PANZER, *Deutschl. Ins.* Heft 8, Tab. 16. The outspread fore-wings have their tips more than 4″ apart, the body is 2″ long. The upper-wings are brown, grey, flamed black and yellow-white, with a small whitish and round spot on the middle; the hind-wings are yellow, with two pale-black bands. The loud noise which these animals make (on the cause of which there are many different opinions) has occasioned the superstitious dread which has sometimes surrounded this insect; to the yellow spot with two black points, which is seen on the *thorax*, and which has some resemblance to a skull, it owes the name of *Death's-head moth*. The caterpillar feeds on the leaf of the potato.

*b) Tongue elongate.*

*Macroglossa* OCHSENH. (*Macroglossum* SCOP.) With extremity of abdomen bearded. Tongue very long.

Sp. *Sphinx stellatarum* L., RŒSEL, *Ins.* I., *Pap. nocturn.* Cl. I. Tab. VIII.; SEPP, *Nederl. Ins.* II. 3e Stuk, Tab. I. the *Humming-bird hawk.*

*Pterogon* BOISDUV. (Sp. of *Macroglossa* OCHSENH.)

*Sphinx* BOISDUV., (*Deilephila* and *Sphinx* OCHSENH.) Abdomen conical, with extremity not barbate.

Sp. *Sphinx Ligustri* L., RŒSEL, *Ins.* III. Tab. V.; SEPP, *Nederl. Ins.* I. 3e Stuk, Tab. III. IV.: the flight is sometimes more than 4″ broad, the body is 2″ long; upper-wings brown with white at the point and the posterior margin, hind-wings rose-red with grey-brown margin, and three black transverse stripes; abdomen red above with a brown mid-stripe and black rings. The beautiful green smooth caterpillar, with oblique violet and white stripes, on the syringas and privets, is rare in Holland.

## II. *Wings triangular rotundate, the posterior congruous.*

*Castnia* FABR. Palps distinctly triarticulate. Antennæ clavate, with club elongate, sub-fusiform, not bearded at the apex.

Sp. *Pap. Licus* CRAMER, *Uitl. Kap.* Tab. 223, fig. A; *Castnia Pallasia* ESCHSCH.; O. V. KOTZEBUE, *Entdeckungs-Reise*, III. Tab. VI. fig. 27;—*Castnia acræoïdes* BOISDUV.; GUÉRIN, *Iconogr. Ins.* Pl. 83, fig. 4, &c. All the species hitherto known are from South America.

Comp. on this division J. W. DALMAN, *Prodromus Monographiæ Castniæ*, c. Tabula æn. color. Holmæ, 1825, 4to. These moths make the natural transition to the following family, and are in their *habitus* very similar to some diurnal butterflies; their wings however have a retinaculum.

Add sub-genera: *Coronis* LATR., *Agarista* LEACH and *Cocytia* BOISDUV. (*Monogr. des Zygénides* Pl. I. fig. 1.)

Family XXVII. *Diurna.* Wings mostly erect when the insect is seated, never bridled by a retinaculum. Antennæ in by far the most clavate, abruptly terminated by a capitulum, in a few filiform or subsetaceous, with apex more slender, uncinate. Ocelli none. The caterpillar always with sixteen feet. Chrysalis almost always naked, angulate, attached posteriorly by threads, or suspended vertically, or affixed by a transverse silken cord expanded above the middle of the body. Flight of Imago diurnal.

*Butterflies* (*Rhopalocera* EOISDUV.) These insects have usually clubbed antennæ, which is the case with all our domestic species; when at rest they erect their wings, so that the upper surface of the wing is turned inwards. The genus *Papilio* of LINNÆUS corresponds to this family of later writers.

Comp. on this family, GODART, article *Papillon,* making the entire IX. part of the *Hist. natur., Insectes, of the Encyclopédie méthod.* 1819, and E. DOUBLEDAY, *The Genera of diurnal Lepidoptera, illustrated with colour. plates.* London, 1846 and foll. 4to.

Phalanx I. Posterior tibiæ, as in the preceding families, spinose not only at the extremity, but also on the inside before the extremity. (Caterpillar very often living among leaves that have been spun together. Chrysalis smooth, folliculate, or tied up by a transverse thread.)

*Urania* FABR. Antennæ filiform, more slender at the apex, and arcuate or uncinate. Labial palps triarticulate, elongate, slender, with second joint greatly compressed, third slender, subcylindrical, almost naked. Wings broad, large.

Sp. *Urania Leilus, Papilio (Eques) Leilus* L., KLEEMAN, *Beyträge,* Tab. II. fig. 1, South America;—*Urania Boisduvalii* GUÉRIN, *Uran. Fernandinæ* MAC LEAY, GUÉRIN, *Iconogr. Ins.* Pl. 82, fig. 1; the larva, the web and the pupa figured in *Trans. of the Zoolog. Soc.* I. 2, 1834, pp. 179—189, Pl. 26. The larva is thick, with a few hairs, in form not unlike a caterpillar of *Callimorpha,* but with a very large head; the web is thin, so that the pupa is visible through the meshes. These species belong to the genus *Cydimon* of DALMAN, *Pap. (Eques) Orontes* L. (CRAMER, *Uitl. Kap.* Tab. LXXXIII. figs. A, B) to the genus *Nyctalemon* of the same.

*Urania Riphæus* CRAMER, *Uitl. Kap.* Tab. CCCLXXXV. fig. A, B; BOISDUVAL, *Nouv. Ann. du Muséum,* II. 1833, Pl. 14, figs. 1, 2, has a spiny caterpillar with the first four membranous feet short, so that it moves like a geometric caterpillar. It does not spin itself up when about to change to a pupa, but affixes itself by means of a thread stretched transversely over the body, like the caterpillars of the genus *Pieris,* &c. This species, placed

by DALMAN under *Cydimon*, forms the type of a separate sub-genus *Urania* or *Thaliura* DUNCAN.

The affinity with *Castnia*, especially with *Coronis* and *Agarista*, cannot be mistaken; and some writers, amongst whom is WESTWOOD, place *Urania* in the former family. In those species, however, which I have examined, I can discover no *retinaculum*.

*Hesperia* FABR. (in part), CUV., LATR. Head thick. Antennæ remote at the base, capitate. Palps short, with second joint extremely scaly forwards, and third joint short. Upper wings erect only when at rest, or expanded wings patent. Caterpillar often living in leaves webbed together.

Sub-genera: *Eudamus* BOISDUV., *Pamphila* FABR., *Hesperia* FABR., *Syricthus* BOISDUV., *Thymele* FABR., *Tanaos* BOISDUV.

Sp. *Hesperia malvæ* FABR., RŒSEL, *Ins.* I., *Pap. diurn.* Cl. II. Tab. x. &c.

Phalanx II. Posterior tibiæ spiny at the extremity or spurred alone. Four wings erect when at rest. Antennæ always capitate or thicker towards the extremity. Caterpillar in the open air. Chrysalis most frequently naked and angulate. (Antennæ in all approximate at the insertion.)

I. Third or last joint of labial palps most distinct, naked or slightly covered with scales or hairs. Claws of tarsi small. Caterpillars oval, resembling *onisci*. Pupæ smooth, rotundate.

*Polyommatus* LATR., nob. Six ambulatory feet in both sexes.

*a*) Labial palps elongate, produced in front of head.

*Myrina* FABR.

*b*) Labial palps short or moderate.

*Polyommatus* LATR., GODART. (*Lycæna, Thecla, Hesperia* FABR. *Syst. Glossat.*)

Sp. *Polyommatus betulæ, Pap. betulæ* L. SEPP, *Nederl. Ins.* III. Tab. XII.; PANZER, *Deutschl. Ins.* Heft 21, Tab. 20;—*Polyommatus Phlæas, Pap. Phlæas* L., RŒSEL, *Ins.* III. Tab. 45, figs. 5, 6, &c.

*Erycina* LATR. (*Erycina, Nymphidium, Helicopis, Emesis* FABR. *Syst. Glossat.*) Anterior feet in males imperfect, not ambulatory, very short.

Sp. *Erycina* (*Helicopis*) *Cupido, Pap. Cupido* L. RŒSEL, *Ins.* IV. Tab. III. fig. 7; CRAMER, *Uitl. Kap.* Tab. 164, figs. D—G, from Surinam. All the species of this genus are from South America.

*Note.*—Here, it would seem, ought to be placed the anomalous genus *Barbicornis* GODART, with setaceous, ciliated antennæ, uniting the *Uraniæ* with the *Erycinæ* and *Polyommati*. See fig. in CUVIER *R. Ani. éd. ill., Ins.* Pl. 143, fig. 4.

II. Third or last joint of labial palps in some distinct, beset with scales like the rest, in others small, subindistinct. Claws of tarsi distinct. Caterpillars oblong, cylindrical. Pupa mostly angulate, anteriorly bimucronate, or acuminate.

*a*) *Hexapoda.* Six ambulatory feet, nearly similar in both sexes. Chrysalis tied posteriorly and by a transverse string. Central cell of posterior wings always closed. (Species of the *Succincti* BOISDUV.)

*Papilio* nob. (*Papiliones Equites* and *Heliconii* L., exclusive of some species.) Posterior wings scolloped in the inner margin, not covering the abdomen below. Anterior tibiæ furnished beneath, with a spine in the middle.

Sub-genera: *Leptocircus* SWAINSON, *Papilio* FABR., LATR., (*Teinopalpus* HOPE, *Ornithoptera* BOISDUVAL, DOUBLEDAY, *Papilio* BOISDUV.), *Eurycus* BOISD. (*Cressida* SWAINSON), *Parnassius* LATR. *Thais* FABR.

Sp. *Pap. Machaon* L. RŒSEL, *Ins.* I., *Pap. diurn.* Cl. II. Tab. I.; SEPP, *Nederl. Ins.* I. 2e Stuk, Tab. III.; the *queen-page;* the tips of the outspread upper wings 4″ apart; the largest domestic species of day-butterfly; the wings yellow with black veinures, the fore-wings at the base black; the hind-wings tailed, with a margin of blue, half round spots on a black band, and a red eye-spot bordered with blue and black at the inner side. The green caterpillar has black rings with orange spots, and lives on the leaves of carrots (*Daucus Carota*, &c.) The genus of the Knights butterflies belongs especially to warm countries, the East and West Indies.

*Pieris* nob. (Species of genus *Pieris* SCHRANK). Anterior tibiæ without middle spine. Posterior wings caniculate on inner margin, receiving the abdomen beneath. (Wings mostly rotundate, in many yellow or white or variegated with orange and yellow).

Sub-genera: *Euterpe* SWAINS., *Leptalis* DALMAN, *Leucophasia* STEPHENS, *Pontia* BOISDUV., DOUBLEDAY, *Pieris* BOISDUV., DOUBLEDAY, *Zegris* RAMBUR, *Nathalis* BOISDUV., *Anthocharis* BOISDUV., *Idmais* BOISDUV., *Thestias* BOISDUV., *Eronia* HUEBN., DOUBLEDAY, *Callidryas* BOISDUV., DOUBLED., *Gonepteryx* LEACH, DOUBLED., (*Rhabdocera* BOISDUV.), *Colias* BOISDUV., *Terias* SWAINS., BOISDUV.

Sp. *Pieris brassicæ, Pap. brassicæ* L., RŒSEL, *Ins.* I., *Pap. diurnor.* Cl. II. Tab. IV.; SEPP, *Nederl. Ins.* I. 2e Stuk, Tab. II., *the great white butterfly;*—*Pieris* (*Gonepteryx*) *Rhamni, Papilio Rhamni* L.; SEPP, *Nederl. Ins.* IV. Tab. XXXVII. *the citron butterfly,* &c.

*b*) *Tetrapoda.* Two anterior feet, in males at least, small and recurved. Chrysalis tied posteriorly alone, suspended freely, with head downwards. (*Suspensi* BOISDUV.)

* Anterior feet in males very short, in females like the rest of the feet.

*Libythea* FABR., *Hecaërge* OCHSENH. Palps very long, porrect in form of a pointed rostrum. Wings angulate, anterior falcate, with apex truncated. Discoidal cell of posterior wings closed.

Sp. *Libythea celtis,* FUESSLY, *Archives de l'Hist. des Insectes,* Winterthour, 1794, 4to. Tab. 8, figs. 1—3. Tab. 14; CUV. *R. Ani. éd. ill., Ins.* Pl. 136, figs. 1, 2, in Southern France, the Tyrol and Italy.

** Anterior feet in both sexes very short.

*Biblis* FABR. Palps longer than head, distant, with last joint inflected. Antennæ towards the end incrassated gradually into an elongated club.

Sp. *Biblis Thadana* GODART, *Pap. Hyperia* CRAMER, *Uitl. Kap.* Pl. 236, figs. E, F; CUVIER, *R. Ani. édit. ill., Ins.* Pl. 136, fig. 3, South America, &c.

*Satyrus* LATR. Palps approximate, ascending, extremely hirsute. Nervures of upper wing often inflected at their origin. Discoidal cell of posterior wings closed.

Sub-genera: *Hipparchia* FABR., OCHSENH., *Hætera* FABR., and some others of modern writers.

Sp. *Satyrus Ægeria, Pap.* (*nymphalis*) *Ægeria* L., SEPP, *Nederl. Ins.* I. 1e Stuk, Tab. VI.; PANZER, *Deutschl. Ins.* Heft 28, Tab. 21, &c.

*Morpho* FABR. Antennæ long, gradually thicker towards apex, almost filiform. Wings very large in proportion to the bulk of the body.

Sub-genera: *Pavonia* GODART, *Amathusia* FABR.

Sp. *Morpho Helenor* CRAMER, *Uitl. Kap.* Tab. 36, figs. A, B; CUVIER, *R. Ani. éd. ill., Ins.* Pl. 140, South America &c.

*Brassolis* FABR. Palps short, compressed, approximate, squamate. Antennæ terminated by an obconical club. Posterior wings with discoïdal cell closed, canaliculate on the outer margin for receiving the abdomen. Body thick.

Sp. *Brassolis sophorœ, Papilio* (*Danaus festivus*) *Sophorœ* L., KLEEMANN, *Beyträge,* Tab. IV. figs. 1, 2; CUVIER, *R. Ani. éd. ill., Ins.* Pl. 141, fig. 2, &c.

*Nymphalis* LATR. (With addition of other genera). Palps approximate, erect, squamose. Posterior wings with discoidal cell almost always open, with internal margin canaliculate to receive the abdomen.

*a*) Antennæ gradually passing into an elongate club.

Sub-genera: *Limenitis* OCHSENH. (*Limenitis* and *Neptis* FABR.), *Ageronia* HUEBN., DOUBLEDAY, (*Peridromia* BOISDUV.), *Apatura* FABR., and some others of later writers.

Sp. *Nymphalis Iris, Papilio* (*Nymphalis*) *Iris* L., RŒSEL, *Ins.* III. Tab. 42, fig. 2; PANZER, *Deutschl. Ins.* Heft 79, Tab. 23, &c.

*b*) Antennæ abruptly clavate. Eyes downy.

Sub-genus: *Vanessa* OCHSENH. (*Vanessa* and *Cynthia* FABR.)

Sp. *Nymphalis polychloros, Pap.* (*Nymph.*) *Polychloros* L., RŒSEL, *Ins.* I. Cl. I. *Pap. Diurnor.* Tab. II.; SEPP, *Nederl. Ins.* I. 1e Stuk, Tab. 8; the outspread wings 2½" wide, above brown orange-coloured, with black spots, the hind-wings with a band of semilunar blue spots. The caterpillar of this and other species is furnished with many spines.—Here belong *Nymphalis Io* L., SEPP, ibid. Tab. 7, DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 40, *Nymphalis Urticæ* L., SEPP, ibid. Tab. 2, &c.

*c*) Antennæ terminated abruptly by a short club. Eyes naked.

Sub-genera: *Melitæa* FABR., *Argynnis* ejusd.

Sp. *Nymphalis* (*Argynnis*) *Lathonia, Papilio* (*Nymphalis*) *Lathonia* L., RŒSEL, *Ins.* III. Tab. X. &c.

*Heliconius* LATR. (*Mechanites* FABR., *Acræa* ejusd.), *Heliconia* GODART. Palps short, remote. Abdomen slender, elongate. Anterior wings elongate, oval, the posterior scarcely, or not at all, receiving the abdomen beneath. Discoidal cell of posterior wings always closed.

Sub-genera: *Tithorea, Heliconia, Lycorea,* and others; on which comp. DOUBLEDAY, *Genera* pp. 99, &c. All the species are from America, except sub-genus *Hamadryas* BOISDUV.

Sp. *Heliconius Erato, Papilio* (*Heliconius*) *Erato* L., CRAMER, *Uitl. Kap.* Tab. 177, fig. F; CUVIER, *R. Ani. éd. ill., Ins.* Pl. 133, fig. 3.

*Danais* LATR. Palps remote. Antennæ very long, in some almost filiform, in others terminated by an elongate oval club. Wings triangular, broad, rotundate at the margin; discoidal cell of posterior wings always closed.

Sub-genera: *Euplœa* FABR., *Danais* LATR., *Idea* (*Hestia*) HUEBN. DOUBLEDAY.

Sp. *Idea Agelia* GODART, *Papilio* (*Danaus candidus*) *Idea* L., CRAMER, *Uitl. Kap.* Tab. 193, figs. A, A; DOUBLEDAY l. l. Tab. 13, fig. 1. Amboyna. The species of the sub-genus *Idea* are large, and have white or grey-white wings with black veins and spots. They all belong to the East Indian islands, or to New Holland. Of the sub-genus *Danais*, species are found both in the Western and Eastern hemispheres.

## ORDER IX. *Neuroptera.*

Hexapod insects, with four wings membranous, mostly transparent, reticulate, naked, most frequently equal. Mouth not suctorial, but in most formed for manducation, with mandibles in some obsolete. Females never aculeate, very rarely furnished with borer or exsert oviduct. Metamorphosis in most incomplete, in others complete. Larvæ hexapod.

*Tendon-winged. Neuroptera* L., from *νευρὸν, tendon,* and *πτερὸν,* —*Odonata* and most *Synistata* of FABRICIUS, *Neuroptera* and *Trichoptera* KIRBY. On this order in general I am acquainted with no other special work than that of P. RAMBUR, *Histoire nat. des Insectes Névroptères; Ouvrage accompagné de planches.* Paris, 1842, 8vo, making a part of the *Suites à* BUFFON by RORET. Other works on particular families we shall indicate below.

The *Neuroptera* are insects with four naked, mostly transparent, wings, of which the veinures form a fine net-work. Usually the under-wings are as large as the upper; in many species of *Ephemera*, however, they are very small, and in some entirely absent. The females have no sting; rarely only there exists a borer or an instrument for depositing eggs. Hereby they are distinguished from the *Hymenoptera*, as well as by the lower jaws with the under lip not being produced into a sucker. The number of joints in the tarsus is different in the different genera.

Many insects of this order are, in the state of pupa and perfect insect, carnivorous and truly predaceous. The larvæ for the most part live in water (*Phryganea, Semblis, Ephemera, Libellula*). Some larvæ spin themselves up when they change into pupæ. In the larva of the lion-ant the vessel which secretes the web, an oval sac, is situated in the abdomen; it ends in a tube capable of extrusion; by means of it the larva spins together granules of sand to form a round ball, within which it changes into a pupa. In the larvæ of the genus of the

*Case-nymphs* (*Phryganeæ*) there are, as in caterpillars, two long vessels, which secrete the silken material. In their straight intestinal canal, also, and in the small number of their *vasa urinaria*, these larvæ resemble caterpillars[1]; and on the whole the genus *Phryganea*, although still really belonging to this order, forms a very natural transition to the Lepidoptera, which does not rest merely on general external resemblance or analogy.

In this order many species are met with in which the instinct is surprising, and their economy extremely interesting; we name merely the lion-ant with its crafty device to overpower its prey, and the celebrated mines and buildings of the white ants, or *termites*, &c.

A. *Neuroptera with metamorphosis complete.*

Tarsi in all quinquearticulate.

Family XXVIII. *Phryganidæ* (*Trichoptera* KIRBY). Wings deflected, posterior often broader than anterior, folded longitudinally, the anterior with numerous branched nervures, covered with hairs, coloured. Mandibles obsolete or very small, remote, not convergent. Maxillary palps long, with three to five joints, labial palps short, three-jointed. Prothorax short. (Antennæ with numerous joints, long, mostly setaceous. Ocelli three.)

Comp. C. F. PICTET, *Recherches pour servir à l'Hist. et à l'Anatomie des Phryganides.* Avec pl. color. 1 vol. 4to. Genève, 1834.

*Case-nymphs, Caddis-flies.* The upper jaws are here very small and little developed, as in the last order (SAVIGNY, *Mém. s. l. ani. s. vert.* I. p. 29, Pl. I. fig. 1). The larvæ live in water, in cases open at both ends, composed of small pieces of wood, of small fresh-water shells (in which frequently the inhabitants are still resident), of sand, of duck-weed, of fragments of leaves that have fallen into the water, &c. They fasten these substances together by means of their web; the inner surface of the case, which is very smooth, is also

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[1] RAMDOHR found only four, which agrees with the number in caterpillars, but this requires to be confirmed by further investigation, since LÉON DUFOUR, in the species examined by him, always met with six. However, the *Ephemerinæ* and *Libellulinæ*, *i. e.* by far the greatest number of the *Neuroptera*, have very numerous (30—40) short *vasa urinaria*, like the *Orthoptera;* those which undergo a perfect metamorphosis only six or eight; see LÉON DUFOUR, *Mém. présentés*, Tom. VII., and LOEW in GERMAR'S *Zeitschrift für die Entomologie* IV. (1813), s. 423, &c. (*Bemerkungen über die anatomischen Verhältnisse der Neuropteren.*)

lined with the web. Most species drag the case with them, but others fasten it to stones and creep in and out. These cases protect the larvæ from the persecution of fishes, which are very fond of them; in England, where fishing with the line is brought to a much greater state of perfection than perhaps anywhere else, these larvæ are much used for bait. The larvæ feed on vegetable as well as animal substances. Most of them have white threads at the abdomen, external respiratory organs, gills (see above pp. 262, 263).

The larvæ, when about to change into pupæ, fix these cases firmly and close the openings with crossing threads, that thus form a latticed cover. The pupæ, at first immoveable, quit this dwelling when about to change into perfect insects; it swells and bursts in order to allow the perfect insect an exit. This last is generally brown-coloured, and resembles a nocturnal butterfly. On an evening, at country-houses, it is frequently allured by the light into apartments, and flies round the lamp or candle until, its wings half-consumed, it falls down with violence on the table. The eggs are joined together to form a gelatinous mass, and are deposited by the female on leaves of branches which hang over the water, so that the young larvæ on creeping out may easily fall into their natural abode, if the leaf by falling previously has not already reached the water.

See on the economy of these Insects especially RÉAUMUR, *Mém.* Tom. II. pp. 497—581, and, on the arrangement, besides RAMBUR and WESTWOOD, also especially BURMEISTER, *Handb. der Entomol.* II. 2, 1839, pp. 882—935.

*Phryganea* L. (exclusive of the *Perlæ* GEOFFR.)

A. Antennæ filiform or pectinate.

*Hydroptila* DALMAN. Maxillary palps with five joints. Wings narrow; posterior not plicate.

Sub-genus: *Narycia* STEPHENS. With antennæ pectinate.

B. Antennæ setaceous.

† Maxillary palps with five joints.

*Chimarra* LEACH. Posterior wings not plicate.

*Mystacida* LATR. *Leptocerus* LEACH. Posterior wings plicate. Maxillary palps long, pilose. Antennæ very long.

Sp. *Phryganea nigra* L., DE GEER, II. Pl. 15, figs. 21—23, &c.
Add sub-genera *Odontocerus* LEACH, *Setodes* RAMBUR, &c.

*Hydropsche* PICTET.

*Rhiacophila* PICTET.

*Psychomia* LATR.

B. †† Maxillary palps (of males) with two to four joints.

*Sericostoma* LATR. Maxillary palps in males mostly with two joints, in some with three, dilated, villose externally, often veiling the head.

Sub-genera *Pogonostoma* RAMB., *Dasystoma ejusd.*: with maxillary palps of males three-jointed.

Sub-genera *Trichostoma* PICTET, *Lasiostoma* RAMB., *Lepidostoma* RAMB., *Sericostoma* PICTET: with maxillary palps of males two-jointed.

*Phryganea* PICTET. Maxillary palps of males four-jointed, of females five-jointed, longer than labial, subpilose. Wings with transverse nervures.

Sub-genera *Limnephila* LEACH, *Monocentra*, *Enoicyla*, *Oligotricha* RAMBUR.

*Note.*—For other recorded genera see WESTWOOD, *Generic Synopsis*, pp. 49—51, and BURMEISTER, l. l.

Sp. *Phryganea grandis* L., RŒSEL, *Ins.* II., *Insect. aquatil.* Cl. II. Tab. XVIII.; DE GEER, *Mém.* II. Pl. 13, fig. 1;—*Phryg. rhombica* L., (*Limnephila* LEACH); RŒSEL, ibid. Tab. XVI.; GERMAR, *Faun. Ins. Europ.* Fasc. IX. Tab. 13, &c.

Family XXIX. *Panorpatæ*. Posterior wings expanded. Mandibles distinct. Head with anterior process mostly rostriform; ligula none; labium and maxillæ mostly connate at base. Maxillary palps five-jointed, labial two-jointed. Antennæ filiform, long, multiarticulate.

A. Ocelli three frontal. Wings perfect, reticulate, with longitudinal nervures numerous, transverse few.

*Bittacus* LATR. Feet elongate, slender, tarsi with single claw. Abdomen cylindrical, long. (Habit of *Tipula*.)

Sp. *Bittacus tipularius*, *Panorpa tipularia* FABR., C. DE VILLERS, *Entomol. Linnean.* Tab. 7, fig. 11; SULZER, *Gesch. der Ins.*, Tab. XXV. figs. 7, 8; GUÉRIN, *Icon., Ins.* Pl. 61, fig. 2, habitat in south of Europe.

*Panorpa* L. (exclusive of *P. hyemalis* and *Coa*). Feet moderate, tarsi with two claws, terminated by intermediate pulvillus. Abdomen of males with three posterior segments recurved, last oval, globose, forcipate.

Sp. *Panorpa communis* (and *Pan. germanica*) L., PANZER, *Deutschl. Ins.* Heft 50, Tab. 10; DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 27, fig. 6. The

*Scorpion-fly.* A. BRANTS has given an anatomical survey of this little animal in the *Tijdschr. voor nat. Gesch. en Physiol.* VI. 1839, bl. 173—198, Pl. VII. The pupa is concealed underground; it has been described and figured by F. STEIN, WIEGMANN'S *Archiv*, 1838, s. 330. Taf. 7, figs. 10—13. The larva, with its mode of life and its residence, is still unknown.

B. Ocelli none. Wings imperfect, in males subulate, in females very short, rotundate.

*Boreus* LATR. (Female with triarticulate ovipositor, encased beneath in a bilobed lamella.)

Sp. *Boreus hyemalis, Panorpa hyemalis* L., *Gryllus proboscideus* PANZER, *Deutschl. Ins.* Heft 23, Tab. 18; GUÉRIN, *Iconogr. Ins.* Pl. 61, fig. 4.

*Note.*—Genus *Chorista* KLUG, resembling *Panorpa* in habit and characters, differs from it in the head not being produced into a rostrum. Species from New Holland.

Comp. KLUG, *Versuch einer systematischen Feststellung der Insecten-familie* Panorpatæ *und Auseinandersetzung ihrer Gattungen und Arten; Abhandlungen der konigl. Akad. der Wissensch. zu Berlin, aus dem Jahre* 1836. s. 81—108. c. fig.

Family XXX. *Hemerobini.* Head moderate or small, transverse, with eyes prominent. Mandibles distinct. Mandibles deeply bilobate, with external lobe often palpiform, articulate. Ligula distinct. Labial palps triarticulate. Wings reticulate, with numerous transverse nervures, mostly deflected. Antennæ always composed of many joints, in length very different.

*Raphidia* L. (in part). Palps short, filiform, maxillary quinquearticulate. Antennæ filiform, short. Prothorax elongate, narrow, subcylindrical. Third joint of tarsi bilobed, receiving the minute fourth joint between the lobes, fifth elongate, terminated by double claw. Abdomen of female furnished with ovipositor, exsert, flexible.

*Camel-fly.* These insects live in the state of pupa and nymph under the bark of trees; the nymph begins to move shortly before the last metamorphosis. Comp. A. PERCHERON, *Mém. sur les Raphidies* in GUÉRIN, *Magasin de Zoologie*, 1833, Cl. IX. Pl. 66; FR. STEIN in WIEGMANN'S *Archiv*, 1838, s. 316—330; G. T. SCHNEIDER, *Monographia generis Raphidiæ*, adjectis tabul. VIII. Vratislaviæ, 1843, 4to.

LINNÆUS united the European specimens known to him into one species, *Raphidia ophiopis.* Modern writers distinguish different species; in most, three simple eyes are present; in one species, first described by SCHUMMEL, *Raph. crassicornis*, they are wanting; of this species, SCHNEIDER, *op. cit.*, forms a separate genus, *Inocellia.*

*Mantispa* ILLIG., LATR. Anterior feet raptorial. (Habit of *Mantis*.) Ocelli mostly none.

Sp. *Mantispa pagana, Raphidia Mantispa* L., GUÉRIN, *Iconogr., Ins.* Pl. 63, *fig.* 1, VILLERS, *Entom. Linn.* Tab. VII. fig. 13, &c. Comp. ERICHSON, *Beiträge zu einer Monogr. von Mantispa,* GERMAR'S *Zeitschr. f. Entom.* I. *1838, s.* 147—173.

*Semblis* FABR. (in part; species of *Hemerobius* and of *Raphidia* L.) Maxillary palps filiform, more slender towards apex, with last joint often shorter than the rest. Prothorax quadrate, longer than mesothorax and metathorax. Anterior wings larger than posterior. Antennæ filiform or setaceous, long. Tarsi with two claws, without intermediate pulvillus.

Sub-genus: *Semblis* (species of *Semblis* FABR.), *Sialis* LATR. Ocelli none. Penultimate joint of tarsus cordate. Wings deflected. Antennæ simple, almost of length of body.

Sp. *Semblis lutaria* FABR., *Hemerobius lutarius* L., RŒSEL, *Ins.* II. *Insect. aquat.* Cl. II. Tab. XIII.; GUÉRIN, *Iconogr., Ins.* Pl. 62, fig. 6. The larva lives in water, and has on each side of the abdomen eight jointed threads, which serve for respiration; it leaves the water to change into a motionless pupa in the ground. Comp. on this genus SUCKOW in HEUSINGER'S *Zeitschr. f. organ. Physik,* II. 1828. s. 265—272, Tab. II., and PICTET, *Mém. sur le genre Sialis de* LATREILLE, *Ann. des Sc. nat.* sec. Série, V. 1836. *Zoologie,* pp. 69—80. Pl. 3.

Sub-genus: *Cordalis* LATR. Ocelli three. Penultimate joint of tarsi undivided, small. Antennæ simple, shorter than body. Head broader than thorax, transverse. Mandibles exsert, in males very long, at rest decussate.

Sp. *Semblis cornuta, Raphidia cornuta* L., *Hemerobius cornutus* FABR., DE GEER, *Ins.* III. Pl. 27, figs. 1, 2; habitat North America. (Mandibles of females denticulate within, thicker; of males, subulate, with only one tooth, small, internal before the apex.)

Sub-genus: *Chauliodes* LATR. Ocelli three. Penultimate joint of tarsi undivided, small. Antennæ serrate or pectinate on the inside, shorter than body. Head of breadth of thorax, angustate posteriorly. Mandibles moderate, little or not exsert.

Sp. *Semblis pectinicornis* FABR., *Hemerobius pectinicornis* L., DE GEER, *Ins.* III. Tab. 27, fig. 3, CUV. *R. Ani. éd. ill., Ins.* Pl. 105, fig. 2; habitat in North America.

*Note.*—There is a species in the Leyden Museum from Java, with prothorax orange, wings brown, with round transparent whitish spots, antennæ

serrated. To this DE HAAN gave the generic name *Sialis*. That genus (*Sialis* DE H. not FABR.) is the same as *Neuromus* RAMBUR, *Neuropt.* p. 441, which ought not to be separated from *Chauliodes;* the species which I have indicated is *Neur. ruficollis* of RAMBUR. Another genus of RAMBUR, *Dilar*, unknown to me, with pectinate antennæ in males, appears to be related, but has a greater affinity, as I conjecture from the description and figure, with the *Hemerobii*.

*Hemerobius* L., FABR. (exclusive of species). Palps with last joint thicker, elongo-ovate. Prothorax small, shorter than the other segments of thorax. Wings ample, lanceolate, with costal border broad. Antennæ filiform or setaceous, mostly long. Tarsi with two claws, and intermediate pulvillus.

*a*) Ocelli none.

Sub-genera: *Hemerobius* LEACH, *Drepanopteryx* LEACH, *Megalomus* RAMB., *Sisyra* BURM., *Chrysopa* LEACH, *Polystœchotes* BURM.

*Nymphes* LEACH. (With antennæ short, wings narrow, elongate; habit of lion-ant.)

Sp. *Hemerobius perla* L., (*Chrysopa perla* LEACH,)[1] RŒS. *Ins.* III. Tab. 21, fig. 5, CUV. *R. Ani. éd. ill., Ins.* Pl. 103, fig. 3; *Hemerobius chrysops* L. (*Chrysopa reticulata*), RŒSEL, *Ins.* III. Tab. 21, fig. 4; comp. N. SLABBER, *Verh. der Haarl. Maatschappij*, X. 2, bl. 387—412, with fig.

These broad-winged insects are provided with eyes shining with gold during life; the delicately latticed wings, as transparent as fine gauze, present the colours of the rainbow. The larva lives on plants, and resembles that of the lion-ant; it feeds on leaf-lice, and is covered with a mealy substance, to which the cast-off skins of the leaf-lice adhere, so that the true form of the insect is often quite irrecognisable; the small, oval, white eggs are seated on long thin pedicles upon twigs and leaves.

*b*) Ocelli three.

*Osmylus* LATR.

*Nemoptera* LATR., *Nematoptera* BURM. (species of *Panorpa* L., FABR.) Head produced into a rostrum. Maxillary palps shorter than maxillæ, filiform, more slender towards the apex, with three small terminal joints; external lobe of maxillæ subulate, biarticu-

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[1] G. T. SCHNEIDER, *Symbolæ ad Monographiam generis Chrysopæ* LEACH, Vratislaviæ, 1851. 8vo. c. tab. pictis.

W. F. EVANS, *Monograph of the British Species of the genus Chrysops, Transact. of the Entomol. Soc. of London.* 1847, Vol. V. p. 71, Pl. 9, 10.

late, palpiform. Ligula porrect, pilose. Antennæ filiform, long. Ocelli none. Mesothorax large. Inferior wings narrow, very long, sometimes resembling filaments.

Sp. *Nemoptera extensa* DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 27, fig. 7, GUÉRIN, *Iconogr., Ins.* Pl. 61, fig. 1;—*Nemopt. lusitanica* KLUG, *Panorpa bipennis* ILLIG., GERMAR, *Fauna Ins. Europ.* Fasc. I. Tab. 16, &c. Species from Africa, southern Europe and western Asia.

*Myrmeleon* L. (in part), FABR., LATR., *Myrmecoleon* BURM. Maxillary palps mostly shorter than labial; external lobe of maxillæ forming an internal biarticulate palp. Antennæ not longer than thorax, gradually thickened into a club towards the apex, arcuate. Ocelli none. Prothorax short, transverse; mesothorax large. Wings lanceolate, deflected. Abdomen elongate, cylindrical. Feet short.

Sp. *Myrmeleon formicarum* L., RÉAUMUR, *Ins.* VI. Pl. 34, fig. 7, RŒSEL, *Ins.* III. Tab. 20, figs. 25, 26, PANZER, *Deutschl. Ins.* Heft 95, Tab. 11. The larva of this insect is known under the name of *Lion-ant*, and is far-famed for its cunning. It has six feet, very large upper jaws, a flat head, and a large oval abdomen. It moves slowly, and almost always backwards. Unable to pursue its prey rapidly, it seeks to compass it by subtlety. To that end the lion-ant digs funnel-shaped holes in the sand, by moving constantly backwards in still smaller circles, and casting out the sand with its head. During this work it is almost entirely concealed beneath the sand, the head and jaws alone projecting above it. Should the lion-ant in the meanwhile encounter a little pebble, too large for his jaws, he creeps out of the sand, endeavours to push his abdomen under the pebble, attempts in this way to creep with his load to the edge of the funnel, and repeats the operation until he finally succeeds, although the pebble repeatedly falls off behind him. When his work is completed, the lion-ant lurks under the sand in the middle of the conical cavity, and pushes his two upper jaws out of the sand like open shears, continually during the night; by day he does this more seldom, and only when an insect falls into the hole. Any small insect that ventures incautiously to the edge of this pitfall, and stumbles in the dry sand, is effectually griped by the pincers; should it try to escape, the lion-ant greets it with a shower of sand, and causes it again to tumble down. If the lion-ant has clutched the insect, he shakes and tosses it about, sucks it dry, and casts the empty body as lumber out of his hole. The lion-ant may be most aptly compared to a spider, and like as this weaves nets proportioned to its size, so he makes his funnels larger the larger he grows. When full-grown, he spins grains of sand together for an abode, almost perfectly spherical, in which he changes to a pupa, and from which after four weeks he makes his appearance as the perfect insect which flies by night. Comp. on the economy of this insect RÉAUMUR, *Ins.* VI. pp. 336—386, Pl. 32—34,

RŒSEL, *Ins.* III. pp. 95—116, p. 124, &c., BONNET, *Œuvres*, Tom. IX. 1781, 8vo. pp. 405—413.

This species occurs in Europe principally in southern lands, yet even in some parts of Holland also; in England it seems not to be found. There are still other European species of this genus (as *Myrmeleon pictum* FABR., GERMAR, *Fauna Ins. Europ.* Fasc. VIII. Tab. 16, from Dalmatia and southern Russia, also from the south of France, *Myrm. formica lynx* L., RŒSEL, *Ins.* III. Tab. 21, fig. 2, &c.), and many exotic species, amongst which one is very large, with spotted wings, from the Cape of Good Hope, *Myrm. speciosus* (*Myrm. libelloïdes* L., et auctor. in part) &c.

*Ascalaphus* FABR. Antennæ long (longer than body), terminated abruptly by an obconical capitulum. Abdomen of length of thorax. Head hirsute. Eyes in most divided by a transverse furrow. Remaining characters of the preceding genus.

Sp. *Ascalaphus barbarus* BURM., *Ascal. italicus* DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 26, fig. 2;—*Ascal. italicus* FABR., PANZER, *Deutschl. Ins.* Heft 3, Tab. 23, &c.

*Ascal. Napoleo.* LEFEBVRE, from New Holl. See GUÉRIN, *Magas. de Zool.* 1842, *Ins.* Pl. 92, where many sub-genera are proposed, partly also received by RAMBUR, which must be here omitted. Comp. RAMBUR, *Neuropt.* pp. 341—364.

B. *Neuroptera with metamorphosis incomplete.*

Tarsi with joints often fewer than three.

Family XXXI. *Libellulinæ.* Antennæ short, with few (7—8) joints, the two basal thicker, passing into an acuminate seta composed of the terminal joints. Wings reticulate, with numerous transverse nervures. Mandibles and maxillæ entirely covered by the labia or margins of the exsertile head; palps not exsert. Labium large, trilobed, with broad lobes. Eyes large; ocelli three. Tarsi triarticulate. Larvæ aquatic.

*Libellæ* or *water-nymphs.* These insects in all the states of their life are very greedy and rapacious. The antennæ of the perfect insect have commonly from five to seven joints. The feet are short, especially the middle pair, and bent forwards. Copulation occurs in a remarkable manner, the extremity of the abdomen in the female being bent round like a ring towards the breast of the male. Here are found, on the ventral surface of the second ring of the abdomen, the external organs of generation, a *penis* placed between two horny hooklets, which in *Æshna* and *Libellula* is perforated by

an efferent canal arising from two small vesicles filled with a yellow fluid: these glands are wanting in *Agrion*[1]. The larvæ and nymphs live in the water, and resemble the perfect insects. The under-lip has the form of a mask or hood, and covers the mouth; anteriorly it terminates in two hooks[2]. It is bent round and set upon a long flat pedicle, which the animal can move forward rapidly, whereon the bending disappears; thus the insect supplies itself with a moveable forceps for seizing its prey unawares at a distance with the hooks at the extremity of the under-lip. (See figures in SWAMMERDAM, *Bibl. nat.* Tab. XII. fig. 5, RÉAUMUR, *Ins.* VI. Pl. 36, fig. 4*m*, figs. 10—14, Pl. 37, figs. 4, 6, 7, Pl. 38, figs. 6—8, RŒSEL, *Ins.* II., *Ins. aquat.* Cl. II. Tab. III. figs. 7*b*, fig. 8*c*, Tab. IX. figs. 3, 4; LYONET, *Œuvr. posthume*, Pl. 18, figs. 13—15). The abdomen of the larva ends either with five horny plates, which can be moved from and to each other, or with three fin-like laminæ; it was in these laminæ (in the genus *Agrion*) that CARUS first discovered the circulation of the blood; see above, p. 259.

With LINNÆUS this family forms only a single genus, *Libellula*.

Comp. on this family VAN DER LINDEN, *Agriones Bononienses descriptæ. Opuscoli scientifici.* Bologna, 1823, Tom. IV. p. 101; ejusd. *Æshnæ Bononienses*, ibid. p. 158, &c.; ejusd. *Monographiæ Libellulinarum Europæarum specimen.* Bruxellis, 1825; TOUSSAINT DE CHARPENTIER, *Libellulinæ Europææ descriptæ et depictæ*, cum Tabulis 48 color. Lipsiæ 1840, 4to; E. DE SELYS LONGCHAMPS, *Monographie des Libellulines d'Europe*, Paris et Bruxelles. 1840, 8vo; and the same author's different short communications in the 6th and 7th parts of the *Bulletins de l'Acad. des Sc. de Bruxelles*.

A. Intermediate lobe of labium very small, lateral lobes very broad, without articulate style.

*Libellula* FABR. Eyes large, often contiguous. Ocelli disposed in a triangle. Wings horizontal, expanded, anterior different from

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[1] Fuller information concerning these parts may be found in H. RATHKE, *De Libellularum partibus genitalibus.* Cum Tab. æn. III. Regiomonti, 1832. 4to. Because the *penis* is not connected with the *testes*, of which the *vasa deferentia* terminate at the ninth ring of the abdomen, RATHKE was of opinion that the union observed in the *Libellulinæ* is not a true copulation, but only precedes it. VON SIEBOLD, however, detected *spermatozoa* in the male at the base of the abdomen, so that the male, by bending round the abdomen towards the thorax previous to copulation, seems to deposit the *sperma* there. WIEGMANN'S *Archiv f. Naturgesch.* 1838, p. 375.

[2] These nippers are the *palpi* of the under-lip; see A. BRULLÉ, *Observations sur la bouche des Libellulines, Ann. de la Soc. Entomol.* II. 1833, pp. 343—351, Pl. 13.

posterior in the structure of the cells, supplied with basal cell resembling a right-angled triangle inverted.

Sub-genera: *Libellula*, *Epitheca* CHARPENT. (*Libella* SELYS). *Cordulia* LEACH. (*Epophthalmia* BURMEISTER, and other genera of RAMBUR; see his *Névroptères*, pp. 24—152.)

Sp. *Libellula depressa* L., RŒSEL, *Ins.* II., *Ins. aquat.* Cl. II. Tab. VI. fig. 4, Tab. VII. fig. 3, DUMÉRIL, *Cons. g. s. l. Ins.* Pl. 28, fig. 6;—*Libellula ænea* L. (*Cordulia ænea*), PANZER, *Deutschl. Ins.* Heft 88, Tab. 20.

To the right-angled triangle, at the base of the fore-wings, as character of this genus, I directed attention in a short communication in the *Bijdragen tot de natuurk. Wettenschappen.* III. bl. 335—339. Pl. III., and *Ann. des Sc. nat.* XV. 1823, pp. 424—427. Pl. XI. *b*.

B. Intermediate lobe of labium broader than lateral; lateral lobes supplied with moveable appendix at apex, sometimes composed of many joints.

*Æshna* FABR. Eyes large, approximate. Ocelli often disposed in a transverse row. Wings expanded.

*a*) *With eyes contiguous.*

Sub-genera: *Anax* LEACH, *Æshna* ejusd., *Gynacantha* RAMBUR.

Sp. *Æshna grandis*, *Libellula grandis* L., RŒSEL, *Ins.* l. l. Tab. IV. &c.

*b*) *With eyes approximate, not contiguous, or remote; with head transverse.*

Sub-genus: *Lindenia* DE HAAN, V. D. HOEV. (*Diastatomma* BURM.)

*Note.*—Here are to be referred sub-genera *Gomphus*, *Cordulegaster* and *Petalura* LEACH, and some others proposed by RAMBUR, op. cit. p. 153.

*Agrion* FABR. Eyes remote. Head transverse, much broader than thorax. Wings narrow, erect when the insect is seated. Middle lobe of labium deeply bifid. Abdomen slender, cylindrical, often very long.

Sp. *Agrion puella*, *Libellula puella* L. (is a collective name for different European species, and thus it is arbitrary to adopt it as a synonym), *Agrion furcatum* CHARPENT.; RŒSEL, *Ins.* l. l. Tab. XI. fig. 7;—*Agrion virgo*, *Libellula virgo* L., RŒS. l. l. Tab. IX. figs. 5, 6, &c.

Sub-genera: *Lestes*, *Calepteryx*, *Agrion* LEACH, *Mecistogaster* RAMBUR, and some others of this author, l. l. p. 217.

Family XXXII. *Ephemerinæ*. Parts of mouth soft. Antennæ very short, subulate, triarticulate. Tarsi quinquearticulate, with first joint mostly very short, scarcely distinguishable. Posterior wings less than anterior, sometimes none. Abdomen terminated by two or three filaments.

*Ephemera* L. (Characters of the family.)

*May-Flies, bank-bait.* The larvæ and nymphs live at the bottom of the water between stones, or in the ooze; some dig horizontal passages, in which they move very rapidly. In these two states they live two or three years before changing into perfect insects; they proceed from very small eggs. The larva has always three threads at the abdomen, of which the middle one in many species disappears after the metamorphosis; it is distinguished especially from the perfect insect by longer antennæ, by stronger upper jaws, and by external respiratory organs at the first six rings of the abdomen; the air-tubes appear as free threads or little plumes, or are united by membrane to form a foliated lamina. Some larvæ have on each side of every ring two such plates. The change from nymph to perfect insect occurs in *Ephemera Swammerdamii* (*Palingenia longicauda* BURM.) so suddenly that there is almost at the same moment a creeping and a flying creature. In other species, as in those observed by RŒSEL, the change takes place more slowly. They moult once again in their perfect condition; and if we be walking by the banks of the water over which they are flying we often see this moulting performed on our clothes.

In the middle of summer the *May-Fly* takes wing towards evening. The time of flight differs in different species. That which SWAMMERDAM described shews itself nearly three days in succession, about St John's day, in the month of May, and often in such quantities that it is as difficult to count these little creatures as falling snow-flakes. A great many fall into the water a prey to fishes, and at that time, especially at Dordrecht, the roach is noted as being peculiarly fat and good. Hence the name *bank-bait*, *oeveraas* (in some parts of France *la manne*). According to the relation of SCOPOLI they are collected by the country-people in Carniola to manure the land (*Entomol. Carniol.* p. 264).

SWAMMERDAM, in the species described by him, did not observe the copulation, and supposes that the eggs, as in fishes, are first laid, and afterwards fertilised by the male. RÉAUMUR doubted this, because the eggs sink in water. But RŒSEL, DE GEER, and later writers, have actually observed the copulation in other species; and thus it is improbable that the species of SWAMMERDAM forms an exception on this point.

*Ephemeræ* on the whole live as perfect insects but a short time, some not even a single day. Once however I kept some specimens of *Ephemera diptera* (*Cloë diptera* PICTET) for some days alive under a glass, two for more than a week.

"*Ephemeræ larvæ natant in aquis; volatiles factæ fruuntur gaudio, uno sæpe eodemque die nuptias, puerperia et exsequias celebrantes.*" LINNÆUS, *Syst. natur.* I. ed. XII. p. 906.

Comp. on this family:

*Ephemeri vita* of *Afbeeldingh van's menschen leven door* J. SWAMMERDAM. Amsterdam, 1675 kl. 8vo. m. afb. (For the facts see *Bijbel der natuur*, I. bl. 234—270, Tab. XIII—XV.)

RÉAUMUR, *Mém. p. servir à l'Hist. des Ins.* VI. pp. 457—522; DE GEER, *Mém.* II. pp. 617—660. Pl. 16—18.

F. J. PICTET, *Hist. nat. des Insectes Névroptères, Seconde Monographie, Famille des Ephémerines.* Genève, 1843. 8vo. avec pl.

A. *Wings with transverse nervures few, posterior often obsolete.*

1) *Compound eyes two both in males and females.*

Sub-genera: *Oligoneuria* PICTET (Wings four), *Cœnis* STEPHENS, PICTET (Wings two).

2) *Eyes four in males; the two accessory large, petiolate.*

Sub-genus *Cloë* LEACH, BURM., PICTET. Posterior wings very small or obsolete. Caudal setæ two.

B. *Wings four, with transverse nervures numerous.*

1) *Two accessory eyes in males, as in the preceding genus.*

Sub-genus: *Potamanthus* PICTET. Caudal setæ three.

2) *Compound eyes only two in both sexes.*

Sub-genus: *Bœtis* LEACH, PICTET. Caudal setæ two.

Sub-genera: *Ephemera, Palingenia* BURM., PICTET. Caudal setæ in females three, in males the intermediate one sometimes shorter or abortive.

Sp. *Ephemera Swammerdamia* LATR., *Palingenia longicauda* PICTET, SWAMMERD. l. l. Tab. XIII.;—*Ephemera vulgata* L., HOUTTUYN, *Natuurl. Histoire*, XIIe Stuk. Pl. 94, fig. 1, PICTET, l. l. Pl. 3, &c.

Family XXXIII. *Perlariæ*. Mandibles distinct, denticulate. Maxillæ with palps five-jointed, filiform or setaceous, and accessory palp, mostly biarticulate (*galea*); labial palps triarticulate; lingula emarginate. Antennæ long, setaceous, multiarticulate. Wings (insect at rest) cruciate, incumbent on the back horizontally; inferior broader than superior, folded longitudinally like a fan. Tarsi with three joints, the last with two claws, and intermediate pulvillus.

*Perla* GEOFFR. (Species of *Phryganea* L., *Semblis* FABR. in part). Characters of family.

These insects were first distinguished by GEOFFROY as a separate genus, whilst LINNÆUS placed them amongst the *Phryganeæ*, to which they have some relation by the broad posterior wings. Till within a few years it was generally supposed by writers that the *Perlæ* have a complete metamorphosis, in consequence of an imperfect observation of NOLLET, recorded by RÉAUMUR. PICTET however has announced the metamorphosis to be incomplete; the larvæ do not live in cases, but mostly in running water, by preference under stones. Some have at the thorax external respiratory organs; others breathe through closed *stigmata*, which have the same situation as the future apertures of the perfect insect, and take in the air by *endosmose*. They have constantly two threads at the hinder part of the body, which sometimes disappear in the perfect insect, but in many species persist at that period. The males of some species have short wings, merely *rudimentary*.

Comp. on this family, of which more than a hundred species from all parts of the world are now known (through later investigations and discoveries), PICTET, *Mém. sur les larves de Némoures, Ann. des Sc. nat.* XXVI. 1832, pp. 369—391. Pl. 14, 15; ejusd. *Mém. sur les metamorphoses des Perles, Ann. des Sc. nat.* XXVIII. 1833, pp. 44—65, Pl. V. VI. and his *Hist. nat. des Insectes Névroptères, Première Monographie, Famille des Perlides.* Genève, 1841. 8vo.

Sub-genera: *Perla* LATR., mihi (*Kollaria* PICTET, *Eusthenia* WESTWOOD, *Pteronarcys* NEWM., *Perla* PICTET), *Capnia* PICTET.

*Anematura* mihi (*Nematoura* LATR., PICTET).

*Note.*—This family with the following approaches by natural affinity very nearly to the *Orthoptera*.

Family XXXIV. *Termitinæ*. Mandibles horny, strong, denticulate. Maxillæ furnished with an appendage or lobe resembling a galea, and with a palp four or five-jointed. Antennæ filiform or setaceous, of the size of thorax at least, composed of more than ten joints. Wings deflected or incumbent, with few transverse nervures, sometimes absent; posterior wings not broader than anterior, in many less than anterior. Tarsi with two to four joints.

*Psocus* LATR. Antennæ setaceous, long, with joints cylindrical, elongate. Maxillary palps four-jointed, labial none. Wings either none or deflected, unequal, posterior less. Tarsi in most with only two, in some with three joints.

Sp. *Psocus pulsatorius*, *Termes pulsatorium* L., DE GEER, *Ins.* VII. Pl. IV. fig. 1, SULZER, *Kennz. d. Ins.* Tab. XXII. fig. 144; the *wood-louse* (*houtluis*); the body pale yellow, with yellow eyes. This insect is commonly found on wood, upon walls, in old papers, &c.; it has superficially a resemblance to a louse, but runs very rapidly. The Latin specific name is derived from the idea that the ticking in old furniture and door-posts, which superstition often receives as a bad omen, is caused by this insect; on the contrary, they are small beetles which cause the tapping sound. An anatomical investigation of this little animal was published by NITZSCH in GERMAR u. ZINCKEN, *Magazin der Entomol.* IV. 1821, s. 276—282, Tab. II.

Other winged species are met with on trees, as *Psocus quadripunctatus* LATR., PANZER, *Deutschl. Ins.* Heft 94, Tab. 22, &c.

Here belong sub-genera *Atropos* LEACH (*Troctes* BURM., *Atropos* and *Lachesilla* WESTW.), *Thyrsophorus* BURM., *Cœcilius* CURTIS.

*Termes* L. (in part), LATR. Labium quadrifid, with palps three-jointed. Antennæ short, mostly moniliform. Wings narrow, incumbent horizontally on the body, longer than body, deciduous, sometimes none. Tarsi with four joints.

These insects bear, in different tongues, the name of *white ants*; they live, like these, in society together, and in warm countries cause incredible damage. Of the wood-work which they destroy, they leave the surface untouched, so that every thing externally preserves its form, but falls to pieces on the slightest touch. The hardest wood cannot resist these animals; glass, metal, and stones alone do they leave uninjured. Some species live underground, others in trees; some erect pyramidal mounds above the surface, which in Guinea and other regions of the African coast are raised to the height of twelve feet, and are so stable that they may be mounted

with safety (*Termes fatalis* L., *Termes bellicosus* SMEATHM.) Below, in the middle of the building, is the residence of the female (monstrous is the distension of the abdomen in a pregnant female which lays perhaps 80,000 eggs); round about this residence are cells for the eggs, magazines for food, &c., all orderly arranged. The uppermost part of the hill-like dwelling is massive, to give more firmness, and to guard the family from the influence of weather and the attacks of foes. It is generally supposed that the labour of building in these societies is performed by the larvæ, but perhaps it is by the sexless individuals who have not got their wings; they have no eyes. There are still other wingless individuals, also without eyes, but with larger jaws; these are commonly called *soldiers*, because they ward off attacks and always stand at guard. When these insects attain their perfect state they leave the dwelling at nighttime; on the day following their dried wings fall off, and they are in great part eaten up by birds, lizards, and even by the negroes. A fertilised female is borne off by the larvæ to a dwelling, and there she lays her eggs. According to SMEATHMAN the workers would seem to carry off a male and a female with them, in order to shut them up and feed them for copulation.

Comp. SMEATHMAN in *Philosophical Transactions*, Vol. LXXI. 1781. The figures are copied in part by BLUMENBACH *in Abbildungen naturhistorischer Gegenstände*, Nos. 9, 10.

Add genus *Embia* LATR. Head broader than thorax. Wings not longer than body. Tarsi triarticulate.

## ORDER X. *Hemiptera.*

Hexapod Insects, with four wings, all membranous or anterior coriaceous at base, thicker. Mouth with articulate rostrum (labium), which ensheathes setæ (mandibles and maxillæ); palps none. Metamorphosis, with few exceptions, incomplete.

*Half-winged* (*Hemiptera* from ἥμισυς *half*, and πτερόν). This order originated indeed with LINNÆUS, but is now limited differently, since the *Orthoptera* have been separated from it as a distinct order. FABRICIUS, who also placed the flea here, named the half-winged insects *Rhyngota*, which name BURMEISTER properly changed into *Rhyncohta*. On this order, amongst other works, we notice:

J. C. FABRICII *Systema Rhyngotorum*. Brunsvigæ, 1803, 8vo; *Hist. nat. des Insectes Hemiptères*, par C. J. B. AMYOT et AUDINET

SERVILLE, *Ouvrage accompagné de Planches*, Paris, 1843, 8vo (a part of the *Suites à* BUFFON by RORET).

As illustrated works: C. STOLL, *Cicaden en Wantsen*, Amsterdam, 1788, 4to (two parts with Dutch and French text); J. R. SCHELLENBERG, *Cimicum in Helvetiæ aquis et terris degentium genus*, Turici, 1800, 8vo (with 14 coloured plates); J. F. WOLFF, *Abbildungen der Wanzen*, v. Hefte, Erlangen, 1800—1811, 4to; C. W. HAHN, *Die wanzenartige Insecten, getreu nach der Natur abgebildet und beschrieben*, Nürnberg, 1831, and subsequently, since 1836 continued by HERRICH-SCHÆFFER.

LÉON DUFOUR treated of the anatomy of these insects in a monograph, entitled *Recherches anatomiques et physiol. sur les Hemiptères*, Paris, 1833, 4to av. 19 pl.

The *Hemiptera* are commonly provided with four wings, of which the anterior are leathery at the base, thick, and not transparent, and at the point membranous (*hemelytra*), or are membranous like the posterior wings, but often stronger and larger than these. The mouth consists of a sucker composed of threads and a case. The case is tubular, grooved above, and consists of joints; it corresponds to the under-lip of other insects. The small upper-lip becoming thinner forwards, covers the base of the sucker. In the groove formed above by the turnover margins of the under-lip, there lie in appearance three setæ, but the middle one is double (the two under jaws (*maxillæ*) and the two lateral threads are the upper jaws[1]). The maxillary palps are entirely absent; so also are the labial palps, or these last are only in quite a rudimentary state[2]. Thus the beak of the *hymenoptera* is constructed for sucking. The fine threads (*setæ haustelli, mandibulæ, maxillæ*) make a wound in the parts of plants or animals, on the fluid or blood of which they feed, the fluid ascending between the threads to the œsophagus above.

The antennæ have commonly only four or five joints, extremely seldom more than eleven. Many species have two or three simple eyes. There are never more, but often fewer, than three joints in

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[1] G. R. TREVIRANUS was the first who distinguished the four threads in *Cimex rufipes* (*Annalen der Wetteravischen Gesellschaft*, 1 Bd. 2 Heft, 1809. s. 171). SAVIGNY has shewn the analogy with the oral organs of other insects, and figured the four filaments in *Cimex nigricornis*, and in a *Nepa*, *Mém. s. l. ani. s. vert.* 1. 1816. Pl. IV.

[2] SAVIGNY, l. cit. Pl. IV. fig. 30, p. 37.

the feet. The metamorphosis is incomplete, with only few exceptions (the males of the gall-insects and the genus *Aleurodes*).

With respect to the natural affinity of this order, and its place in a natural arrangement of insects, we remark that it agrees with the *Orthoptera* in the imperfect metamorphosis, but differs from this order very greatly in the oral organs and in the internal structure. The last family of the preceding order, the *Perlæ* and *Termites*, on the contrary, have a position very close to the *Orthoptera*; and it is only with reluctance that we interrupt this natural transition by interposing the *Hemiptera* between them. But the *Hemiptera*, whatever position be allotted them, must always stand by themselves as a very deviating group of insects. The absence of maxillary palps might perhaps be considered to be their most important character, which elsewhere in the class of insects are more constant in their presence than the labial palps[1]. Some species of *Hemiptera homoptera* (the genus *Flata*) have some resemblance to the *Lepidoptera*, which however, is rather an external similarity (*analogy*) than a true relationship (*affinity*).

The intestinal canal of the *hemiptera* is long, (see above, p. 253). In many *Cicadariæ* (*Cicada*, *Ledra*, *Cercopis*, &c.) there is an arrangement, which was formerly considered to be a return of the intestine into the stomach, but which has been since described by Doyère in a more satisfactory manner; the tortuous intestinal canal does turn back to the stomach and attaches itself to it, to leave it subsequently at another point; but it does not open into the stomach, but merely runs along its wall, between the coats of the organ[2]. In some *Geocorisæ* (*Scutellera*, *Pentatoma*, and some species of *Coreus*) the inferior part of the stomach before the insertion of the *vasa urinaria* is tortuous, and consists of four (in *Coreus marginatus* of two) grooves or semi-canals, which have transverse white rings or folds of even width, between which there is a very thin and transparent membrane[3]. Salivary glands are ordinarily much developed; mostly more than one pair are present; they are situated on each side of the intestinal canal, and open into the œsophagus; in the leaf-lice they appear to be wanting.

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[1] Ratzeburg indeed describes in *Cicada* a three-jointed maxillary palp (*Mediz. Zool.* II. Tab. 27, figs. 16, 17); but this part, according to Burmeister, is a jointed horny process, to which muscles are attached.

[2] *Ann. des Sc. nat.* 2e Série. Tome XI. 1839, pp. 81—85. Pl. 1.

[3] Ramdohr has given to this part the name of *Wanzenmagen*.

The disagreeable smell, peculiar to most *heteroptera*, seems for their protection, and is caused by a fluid that escapes through two apertures, one on each side, beneath the thorax at the insertion of the third pair of feet. According to LÉON DUFOUR this fluid is secreted by a small round or oval pouch, commonly of a yellow colour, which is situated in the abdomen; it is rarely double.

Many genera of *hemiptera* are met with only in warm countries, and the European species form but a small part of the numerous order.

Section I. *Homoptera.* Elytra deflected, in most coriaceous or membranous, similar to posterior wings, but larger and stronger. Rostrum rising from the inferior part of head, inflected beneath the breast between the bases of the feet. Thorax gibbous, with first segment shorter.

In this division, which as well as the second, WESTWOOD ranks as a distinct order, the upper wings are constantly of a similar substance, and not half-horny or leathery and half-membranous. The antennæ consist in many of more than six joints. The beak lies on the breast (*rostrum pectorale*). All live on juice of plants. The females often have an instrument for laying their eggs, composed of three filaments, toothed plates or saws, enclosed between two valves.

A. Metamorphosis (in males at least) complete.

Family XXXV. *Coccina* (*Gallinsecta* RÉAUM.) Males winged, with mostly two wings, without rostrum. Wings without cells, with only two longitudinal nervures. Antennæ mostly with nine to eleven joints.

Females (one genus excepted) apterous, attaching themselves to trees or herbs at the time of parturition, sometimes assuming the form of a gall, their own vesicular dead bodies covering their eggs.

*Gall-insects.* These insects were thus named by RÉAUMUR from a superficial resemblance of the pregnant female to a gall-nut. (See above, p. 384). The joints of the tarsus have not been given by us amongst the characters on account of the minuteness of the objects and the prevalent uncertainty; for whilst many writers (*ex. gr.* LATREILLE and WESTWOOD) ascribe one joint alone to this family, and distinguish it principally by this, others assign three (BOUCHÉ

even four) joints. The character also of a single claw alone at the end of the tarsus is not constant.

Comp. on this family, RÉAUMUR, *Mém. pour serv. à l'Hist. des Ins.* Tom. IV. (*Mém.* 1 et 2), pp. 1—122; RATZEBURG, *Mediz. Zool.* II. pp. 214—228, *Forst. Ins.* III. s. 188.

*Coccus* L. (in part). Wings two and often poisers in males; females apterous. Abdomen in males with two terminal setæ. Rostrum of females short, with long exsertile setæ concealed and inflected in abdomen.

Sub-genera: *Lecanium* ILLIG., *Coccus* BURM., *Pseudococcus* WEST.

To this division, and indeed especially to *Lecanium*, what we advanced in the characters of the family respecting the females has reference; to this genus alone the name *Gallinsecta* is appropriate. To it belongs *Coccus Ilicis* L., *Lecanium Ilicis* ILLIG., RÉAUMUR, op. cit. Pl. V.; in the south of Europe and in the East,—the *kermes* of the Arabians, from which word the appellation *karmozijn, crimson*, for a red colour, is derived. This insect, formerly used in medicine, now only as a dye, has however lost much of its value since the introduction of the *Cochenille* from America (Mexico), which first came to Europe in 1526. The last-named species, *Coccus cacti* L., lives upon the *Nopal, Cactus coccinellifer* (*Opuntia coccinellifera* DECAND.), cultivated with that view. See figures of the insect in DUMÉRIL, *Consid. gen. s. l. Ins.* Pl. 39, fig. 2, BRANDT u. RATZEB. *Medizin. Zool.* II. Tab. 26, figs. 5—12, 16, 17, BURMEISTER, *Handb. der Entomol.* II. Taf. II. fig. 1. It is computed that 70,000 dried insects go to a pound of cochenille, and formerly 880,000 pounds of this dye were imported. Comp. on the Cochenille, *Natuurlijke Historie van de Cochenille, bewezen met authentique Documenten* (door M. DE RUUSSCHER), Amsterd. 1729, 8vo; THIERRY DE MÉNONVILLE, *Traité de la culture du Nopal et de l'éducation de la Cochenille.* Av. pl. Cap français, Paris et Bordeaux, 1787. 8vo. On the introduction of this insect into our East Indian possessions, a report may be found in the *Alg. Konst-en Letterbode*, 1829. No. 30.

Another species, *Coccus ficus* FABR. (probably a species of *Lecanium*), lives in Bengal on different species of *Ficus* and other plants; the young insects are seated close together on the young shoots, and round about the place where they have sucked themselves fast, there drops a thick fluid, which hardens into a tough transparent substance, the *gum-resin, gummi-lacca*. The dye of this substance is used under the name of lac (*lac-dye, lac-lake*), as a very beautiful substitute for cochenille, and the *shell-lac* deprived of the colouring matter as a component of lac-varnish, of sealing-wax, and as an isolating body in electrical apparatus. See on this insect KERR, *Phil. Transact.* Vol. LXXI. *for the year* 1781, pp. 374—382.

*Coccus manniparus* EHRENB., *Symbol. phys., Ins. Dec.* I. Tab. 10; comp. GEIGER'S *Journal der Pharmacie*, Juli 1830; on *Tamarix mannifera* in the neighbourhood of *Sinai*, &c.

*Margarodes.* See LANSDOWN GOLDING, *Transact. of the Linn. Soc.* XVI. 1.

*Calypticus* COSTA, *Aspidiotus* BOUCHÉ, BURM.

*Monophlebus* LEACH, BURM.

*Porphyrophora* BRANDT.

*Dorthesia* BOSC. Wings two and poisers in males; females apterous. Antennæ of male nine-jointed, long, setaceous; of female eight-jointed, short, subulate. Abdomen of male terminated by a pencil of cilia.

Comp. BOSC, in *Observations sur la Physique*, &c., par ROZIER. 1781. pp. 171—173, DORTHES, ibid. XXVI. 1786, pp. 207—211, BURMEISTER, l. l. figs. 6, 11.

*Aleurodes* (*Aleyrodes*) LATR.

*Note.*—Genus *Aleurodes* (*Aleyrodes*) LATR., seems rightly to be referred to this family by BURMEISTER. Metamorphosis complete, as in males of *Cocci;* pupa quiescent, folliculate. Also anterior wings sufficiently similar to wings of *Cocci.* But the number of wings (four), which are not wanting in females, the rostrum too, with which, as it seems, the males also are furnished, seem to indicate the separation of this genus from the *Coccina*, and accordingly LATREILLE joined it with the *Aphidii*, and lately, HARTIG with the *Psyllæ;* WESTWOOD, however, to avoid a difficulty, preferred creating a small family from the single genus.

Sp. *Aleyrodes Chelidonii* LATR., *Phalæna* (*Tinea*) *proletella* L., RÉAUMUR, *Ins.* II. Pl. 25, figs. 1—7, BURMEISTER, l. l. Tab. I. fig. 12 (larva), Tab. II. fig. 7 (imago), WESTWOOD, *Introd. to mod. Class.*, in plate of Title to Vol. I., HARTIG in GERMAR'S *Zeitschr. f. Entomol.* III. p. 371, Tab. I. figs. 30, 31 (Antenna, wing).

B. Metamorphosis incomplete.

Family XXXVI. *Aphidii* s. *Phytophthires.* Wings four, with nervures longitudinal alone, often ramose or bifid; in some no wings. Tarsi with two joints, the last biunguiculate. Rostrum in both sexes. Antennæ mostly with six to ten joints, longer than head.

*Aphis* L. Antennæ with not more than six or seven joints. First joint of tarsus very short. Fore-wings with marginal stigma. Abdomen mostly supplied posteriorly with two conical tubercles. In most species some imagines are apterous, others winged.

*Leaf-lice, Plant-lice, Pucerons.* These animals live together on different plants and trees, and mostly in very large numbers. They do not leap, but run commonly very slowly. From the hind part of the body there often drops a transparent honey-sweet fluid, of which ants are very fond and on that account are often found in the neighbourhood of the leaf-lice. These suck the sap of the plants, and some species, by puncturing the leaves or leaf-stalks, produce excrescences or swellings occasionally hollow, which are filled with a great number of these animals and often with a considerable quantity of the sweet sap. The sticky fluid on leaves, known by the name of *honey-dew*, is caused by leaf-lice. Most species are covered with a powdery substance or with white threads, (a peculiar secretion of their body).

To counteract the excessive multiplication of leaf-lice, in the great economy of nature, a number of enemies are on the watch, not merely *ichneumons* (see above, p. 378), but insects especially which feed on them and devour large quantities, the pupæ of some *diptera*, of *hemerobii* (p. 418), of beetles (*Coccinellæ*), &c.

LEEUWENHOECK had already noticed that plant-lice are viviparous, that they also lay eggs was first discovered by LYONET; but the succession of generations, the descendants of mothers and grandmothers which are viviparous and fruitful without copulation, was first discovered by BONNET; see above, pp. 263, 264.

Comp. on this group of insects, as numerous in species as interesting in their economy, RÉAUMUR, *Ins.* III. *Mém.* IX. pp. 281—350; C. BONNET, *Traité d'Insectol.* Tom. I. Paris, 1745; DE GEER, *Mém. p. servir à l'Hist. d'Ins.* III. pp. 19—129, and for the systematic arrangement, HARTIG, *Versuch einer Eintheilung der Pflanzenläuse* in GERMAR'S *Zeitschr. f. die Entomol.* III. 1841, s. 359—376, and especially J. H. KALTENBACH, *Monographie der Familien der Pflanzenläuse.* Mit Abbild. Aachen, 1843, 8vo; also T. WALKER, *Descriptions of Aphides, Ann. of Nat. Hist.* sec. Ser. IV. p. 202, V. 1850, pp. 14—28, 269—281, 388—395, VI. pp. 41—48, 118—122.

Some species live on the roots of plants. They have no wings; BOUCHÉ, however (according to RATZEBURG, *Forst-Ins.* III. s. 216), discovered two species of *Rhizobius* that were winged. These species may be collected provisionally under the name of:

*Rhizopthiridium* nob.

Here belongs the genus *Rhizobius* BURM. (a name already given to a genus of *Coleoptera*), and the genera *Paracletus*, *Trama* and *Forda* V. HEYDEN, *Entomol. Beiträge* in *Abhandl. der Senckenb. Gesellsch.* II. 1837, s. 291—295. *Rhizoterus* HARTIG, according to KALTENBACH, does not differ from *Forda* V. HEYDEN.

By far the greatest number of species live above ground on branches and leaves. Amongst these both winged and wingless individuals occur in the same species. The winged individuals have constantly three simple eyes (KALTENBACH).

*a*) Wings horizontal. Abdomen without cornicles or tubercles. (Antennæ short.)

*Phylloxera* BOYER DE FONSC., HARTIG. Antennæ triarticulate, with last joint fusiform, elongate, emarginate, obscurely annulate. Anterior wings with cubital nerve undivided.

*Vacuna* V. HEYDEN, KALTENB. Antennæ five-jointed. Anterior wings with cubital nerve bifid.

*b*) Wings deflected, obliquely erect above the body.

* Cubital nerve undivided.

*Phlœopthiridium* mihi, *Chermes* HARTIG. (Species from genus *Chermes* L.) Antennæ short, thickish, filiform, with five joints. Feet short. Abdomen without cornicles.

*Note.*—*Chermes* is a name by no means to be given to the modern genus, which rejecting all the other Linnæan species, contains one alone (*C. Abietis*); the diagnosis of LINNÆUS himself teaches this. On this and other allied species comp. especially RATZEBURG, *Forst-Ins.* III. pp. 195—205, Tab. XII. These insects appear to be oviparous alone; copulation has not yet been seen.

*Pemphigus* HARTIG. (Spec. *Chermes* BURM.)

*Tetraneura* HARTIG. (Antennæ with six joints.)

* Cubital nerve sending off one or two branches.

*Schizoneura* HARTIG, KALTENB., *Myzoxylus* BLOT (*Eriosoma* LEACH, in part). Cubital nerve bifid. Antennæ short, sex-articulate. Cornicles of abdomen none or obsolete.

Sp. *Aphis lanigera*-HAUSMANN, *Eriosoma mali* LEACH, &c.

*Lachnus* ILLIG., BURM. Cubital nerve trifid. Antennæ sex-articulate, shorter than body. Feet long. Short tubercles alone in abdomen, in place of cornicles. Feet, especially the posterior, long. Rostrum sometimes very long.

Sp. *Lachnus fagi*, *Aphis fagi* L., RÉAUM. *Ins.* III. Pl. 26, figs. 1—6. The abdomen of this species $\frac{1}{3}$''' in size is covered with very long white wool; it looks like a bit of white flue; this species is very often seen on beeches in the groves at the Hague.

*Aphis* ILLIG., BURM. Cubital nerve bifid. Antennæ sept-articulate, longer than body. Feet long. Abdomen with two cornicles.

Sp. *Aphis rosæ* L., Réaumur, l. l. Pl. 21, figs. 1—4; Duméril, *Cons. gén. s. l. Ins.* Pl. 39, fig. 3, &c.

*Psylla.* Geoffr., Latr., *Chermes* L. (exclusive of *Cherm. Abietis*). Antennæ with ten joints, the last bisetose. Tarsi with two equal joints. Wings deflected, ample, with nerves branched. Imagines always winged.

*Leaf-suckers, False leaf-lice, Farinæ pucerons.* The larvæ are covered with a woolly coating, just like leaf-lice. The perfect insect has the *habitus* of a small cicada, the long antennæ excepted. Comp. Réaum. *Ins.* III. *Mém.* X. pp. 351—362; De Geer, *Mém.* III. pp. 130—157. Sp. *Psylla pyri, Chermes pyri* L., Ratzeburg, *Forst-Insecten*, III. Tab. XI. fig. 2, &c.

*Livia*, Latr., *Diraphia* Illig. Antennæ short, thick. Head anteriorly bifid.

Sp. *Livia juncorum* Latr., Duméril, *Cons. gén. s. l. Ins.* Pl. 39, fig. 5; Germar, *Faun. Ins. Europ.* VI. Tab. 21.

Add sub-genus *Livilla* Curtis, Westw.

Family XXXVII. *Cicadariæ*. Wings four deflected, anterior often coriaceous coloured elytra. Tarsi almost always triarticulate, in a few biarticulate. Antennæ short, with three or seven joints, the last setaceous. Females furnished with serrated borer.

Comp. on this family Germar, *Magaz. der Entomol.* III. pp. 177—227, IV. pp. 1—106.

A. *Cicadariæ mutæ*. No musical organs. Antennæ with three joints. Eyes two or none. Tarsi triarticulate.

Phalanx I. *Cicadellæ* Latr. (*Cicadellina* and *Membracina* Burmeister). Antennæ inserted between the eyes. Posterior feet saltatory.

*A*) Prothorax not produced posteriorly above the abdomen. Scutellum distinct. Head horizontal, with frons mostly directed forwards.

†) Posterior tibiæ spinosé or serrate.

*a*) Ocelli none.

*Typhlocyba* Germar. Body elongate. Posterior feet very long.

Comp. especially Herrich Schæffer, *Deutschl. Ins.* Heft 164. Small insects, leaping, mostly yellow or green. European species numerous, amongst which are *Cicada Ulmi* and *Cicada Rosæ* L.

*b*) Ocelli two.

*Tettigonia* LATR., *Cicada* FABR.

* With ocelli on vertex.

Sub-genera: *Cercopis* FABR. in part, *Aphrophora* GERM., *Clastoptera* GERM., *Tettigonia* GERM., BURM., *Euacanthus* GERM., *Ledra* FABR., *Ledropsis* WHITE, *Penthimca* GERM., *Gypona* GERM., *Xerophlœa* GERM.[1]

Sp. *Cercopis spumaria* FABR., *Aphrophora spumaria* GERM., *Cic. spumaria* L., RŒSEL, *Ins.* II. *Locust.* Tab. XXIII. f. 1—4; the larva and nymph live in a white froth (vulg. *cuckoo-spit*) found in spring-time on different plants, especially on willow-trees.

*Tettigonia viridis*, *Cicada viridis* L., &c.

** With ocelli in the margin of frons.

*Jassus* FABR. (Add sub-genera *Cœlidia*, *Paropia*, *Eupelia*, *Acocephalus*, *Bythoscopus* GERM.)

††) Posterior tibiæ unarmed.

*Ulopa* FALL., GERM. Head broad, with eyes somewhat prominent.

*Æthalia* GERM., BURM. (*Ætalion* LATR.) Head deflected anteriorly.

Sp. *Æthalia reticulata*, *Cicada reticulata* L., DE GEER, *Ins.* III. Pl. 33, figs. 15, 16, LATREILLE in HUMBOLDT et BONPLAND, *Observ. de Zool. et d'Anat. comp.* I. Pl. 24, figs. 12, 13. Habit. in South America; forms the transition to the following section.

*B*) Prothorax produced posteriorly above the abdomen, often covering the scutellum, in some the wings also. Head deflected, with frons inferior; ocelli two in vertex.

*Membracis* LATR. (*Centrotus*, *Membracis* [*Ranatra* LESSON[2]], *Darnis* FABR.).

Add sub-genera; *Lamproptera* GERM., *Bocydium* LATR., and several others, on which comp. BURMEISTER, l. l. II. pp. 127, &c. and AMYOT *et* SERVILLE, *Neur.* pp. 532—553.

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[1] Besides these, many other genera have been added by AMYOT *et* SERVILLE, *Hist. nat. des Ins. hémipt.* which from our limited space we cannot record.

[2] This name was given long before to a genus of the water-bugs (*Nepa linearis*).

Sp. *Membracis foliata* FABR., *Cicada foliata* L., STOLL, *Cicad.* Tab. 1. fig. 2; DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 38, fig. 3. Habit. in North America, like many species of this subdivision.

Phalanx II. *Fulgorellæ.* Antennæ inserted under the eyes. Head compressed at the sides, marginate, often elongated anteriorly, inflated. Ocelli, in some none, in others two, approximate.

*A.* Two palpiform appendages at the base of antennæ.

*Cobax* GERMAR, *Otiocerus* KIRBY, BURM. (*Hynnis* BURM. in part).

*B.* Antennæ simple.

*Tettigometra* LATR.

*Issus* FABR.

Sub-genera: *Eurybrachis* GUÉRIN, *Corethrura* HOPE, *Ancyra* WHITE.

Sp. *Ancyra appendiculata* WHITE, WESTWOOD, *Cabinet of Oriental Entomol.* Pl. 36, fig. 5.

*Delphax* FABR.

*Ascraca* LATR. (and *Ugyops* GUÉRIN?)

*Anotia* KIRBY.

*Derbe* FABR.

Sub-genera: *Mysidia, Lydda, Zeugma, Thracia, Phœnice, Patara, Cenchrea* WESTW.

*Flata* FABR.

Sub-genera: *Pœciloptera* LATR., *Ricania* GERM., *Cixia* LATR. &c.

*Lystra* FABR.

Sub-genera: *Aphæna* GUÉRIN, *Poiocera* LAPORTE.

*Fulgora* FABR., BURM.

Sp. *Fulgora laternaria* L., RŒSEL, *Ins.* II. *Locust.* Tab. 29, 30; STOLL, *Cicad.* Tab. 1. fig. 1; the *Surinam lantern-bearer;* the head terminates in front in a bladder-like hollow process, the wings yellow-brown, with brownish stripes meeting reticulately; the under-wings with a large yellow eye-like spot, bordered with black, with two round, white, confluent rings in the middle. It is one of the larger insects of this order (the tips of the fore-wings are 5".6''' asunder; the body with the vesicular process

of the head 2″ 6‴ long). According to MERIAN this insect at night-time diffuses a clear light; which, however, is denied by later writers. As little, according to BOWRING (*Ann. of nat. Hist.* XIV. p. 427), is the Chinese species, *Fulgora candelaria* L., phosphorescent. In Europe, especially in the southern parts, *Fulgora Europæa* L., *Pseudophana europæa*, is met with. See a fig. in PANZER, *Deutschl. Ins.* Heft 20, Tab. 16, and *Naturforscher*, IX. Tab. II.

B. *Cicadæ stridulantes* (*Cicadæ manniferæ*). Males furnished with a musical organ at the base of abdomen on each side. Antennæ with seven joints. Ocelli three. Tarsi in some (genus *Tibicen* LATR.) biarticulate.

*Cicada* OLIV. (species from genus *Cicada* L., *Cicadæ manniferæ*), *Tettigonia* FABR.

*Cicadæ*. These insects are found in warm countries alone, in woody districts especially. The females, when about to lay their eggs, perforate the branches by means of two serrated horny plates, enclosed between two jointed valves and supported at the back by a grooved horny part, formed of two pieces which have coalesced[1]. The larvæ on leaving the egg quit the place, and betake themselves underground, where they suck the roots. Here too they change into nymphs.

The ancients made much of these animals and considered them to be favourites of the Muses, whilst living on dew at the top of high trees they heralded the approach of summer with their clear song, and resembling the gods, as is sung in an Anacreontic ode, had like them no blood in their bodies[2].

The musical organ of the male is situated on each side at the base of the abdomen and covered by a valve. A horny, triangular partition corresponding to the *entothoraæ*, separates the two lateral cavities. Each of these, when viewed from the ventral aspect, presents in front a white folded membrane, but down at the bottom, a stretched, thin and transparent lamina, which RÉAUMUR calls *le miroir*, the *looking-glass* (*Mém.* v. Pl. 17, figs. 1, 2, 3, 6 *m*). If the part be opened from the dorsal surface, another folded membrane is seen, the

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[1] RÉAUMUR, *Mém.* v. pp. 170—178, Pl. 11, WESTWOOD, *Introd.* II. p. 424; DOYÈRE gives a different explanation of the instrument, and thinks that the lateral plates serve for fixing and that the middle piece by pushing penetrates the wood. See *Ann. des Sc. nat.* sec. Série, VII. 1837, *Zool.* pp. 193—199, Pl. 8.

[2] See ARISTOTELES, *de Hist. Animal.* L. v. c. 24 (Ed. SCHN.) vulgo c. 30.

*drum-membrane* (*La timbale*, l. l. figs. 5, 6, 9, 11 *t, t*), which is moved by a very strong muscle arising from the partition mentioned above. When these muscles contract powerfully on each side and then suddenly relax, a vibratory motion arises, producing a sound which is swelled by an air-vesicle, a vesicular *trachea*, that lies near the drum. The sound is the so-called song of the *cicadæ*, which is peculiar to the males, whence XENARCHUS extolled the fortune of these animals, whose wives are dumb.

The so-named *manna*, not to be confounded with that which served the Israelites for food in the Arabian desert, is an exudation from ash-trees in consequence of the puncture of the *Cicada orni*.

Sp. *Cicada orni* L., RŒSEL, *Ins.* II. *Locustæ*. Tab. XXV. figs. 1, 2, Tab. XXVI. figs. 3, 5; BRANDT and RATZEBURG, *Mediz. Zool.* II. Tab. XXVI. figs. 1—4;—*Cicada fraxini, Tettigonia Fraxini* FABR., RŒSEL, ibid. Tab. XXV. fig. 4, XXVI. fig. 4, figs. 6—8, from the south of France, Italy, &c.

Section II. *Heteroptera*. Elytra coriaceous at the base, membranous at the apex. Rostrum frontal, rising from the anterior part of the head.

The insects of this division are the only ones properly to which the name of *hemiptera* is applicable. Some amongst them suck the blood of other animals; others live, like those of the preceding division, on the juices of plants. The anterior segment of the thorax is much larger than the other two. The antennæ have never more than five and ordinarily only four joints.

Comp. on this division F. L. DE LA PORTE, *Essai d'une classification systematique de l'ordre des Hemiptères;* GUÉRIN, *Magas. de Zool.* 1832, *Ins.* Pl. 51—55.

Family XXXVIII. *Hydrocorisæ*. Antennæ inserted under the eyes, recondite, shorter than head or scarcely of length of head, three- or four-jointed. Tarsi mostly biarticulate. Eyes mostly large. Rostrum short.

*Water-bugs*. They live in fresh-water. In the following family also are some species which live in water, but which do not swim as these do, with the exception of the genus *Galgulus* LATR., which WESTWOOD refers to the *Geocorisæ*.

I. Ocelli none.

A. Two anterior feet recurved downwards, with thighs not incrassated; two posterior long, pilose, natatory, sometimes destitute

of terminal claws. Body depresso-cylindrical or oblongo-ovate, thickish.

*Notonecta* L.

† Anterior tarsi uniarticulate.

*a*) Scutellum not distinct, covered by prothorax.

*Corixa* GEOFFR., LATR., (*Sigara* FABR.)

Sp. *Notonecta striata* L., RŒSEL, *Ins.* III. Tab. 29, fig. d; SCHELLENBERG, *Cimic.* Tab. IX.;—*Cor. Geoffroyii* LEACH, *Cor. punctata* BURM., RŒSEL, l. l. figs. a, b, &c.

*b*) Scutellum distinct.

*Sigara* LEACH (species of *Sigara* FABR.)

Sp. *Sigara minuta* FABR., *Notonecta minutissima* L.

†† Anterior tarsi triarticulate. Scutellum distinct.

*a*) Posterior feet terminated by two claws.

*Ploa* STEPH., BURM., *Plea* LEACH.

Sp. *Notonecta minutissima* FABR., (not L.), PANZER, *Deutschl. Ins.* 2, Tab. 20; only 1‴ long.

*b*) Posterior feet with tarsi biarticulate, without claws.

*Notonecta* FABR., (exclu. *N. minutissima*), LEACH, BURM.

Sp. *Notonecta glauca* L., RŒSEL, *Ins.* III. Tab. 27; SCHELLENB. *Cimic.* Tab. X.; PANZER, *Deutschl. Ins.* Heft 3, Tab. 20. *Water-bug*; it swims on its back, and stings severely[1].

B. Two anterior feet cheliform, the tibia and tarsus forming a curved hook to be lodged upon the thighs, incrassated and grooved on their anterior inner margin (*Nepa* L.).

*Naucoris* GEOFFR., FABR. Antennæ quadriarticulate. Head almost as broad as thorax. Anterior tarsi uniarticulate. Body ovate, depressed.

Sp. *Naucoris cimicoïdes, Nepa cimicoïdes* L., RŒSEL, *Ins.* III. Tab. 28; SCHELLENB. *Cimic.* Tab. XII.; PANZER, *Deutschl. Ins.* Heft 95, Tab. 16, &c.

*Belostoma* LATR. Antennæ quadriarticulate. Head small, narrower than thorax, triangular. Anterior tarsi biarticulate. Body ovate, depressed.

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[1] Comp. on this sub-genus LEACH in *Lin. Transact.* Vol. XII. 1818, pp. 10—18.

Sp. *Belostoma grande, Nepa grandis* L., RŒSEL, *Ins.* III. Tab. 26, from South America; *Belostoma indicum* LE PELETIER *et* SERV., STOLL, *Wantzen*, Pl. VII. fig. 4, from the West Indies. The largest species of this order. The stiliform appendage at the abdomen is not, according to SPINOLA, for respiration, and thus does not correspond to the filaments at the abdomen of *Nepa*, GUÉRIN, *Revue zoologique*, 1839, Avril, p. 112.

*Note.*—Sub-genera *Diplonychus* and *Sphærodema* LAPORTE are scarcely distinct.

Sp. *Belostoma rusticum, Nepa rustica* FABR., STOLL, *Wantzen*, Pl. VII. fig. VI. The females carry the eggs on their back, like *Pipæ* amongst the *Batrachoïdea*.

*Nepa* mihi (*Nepa* and *Ranatra* FABR.) Antennæ triarticulate. All the tarsi with only one distinct joint. Abdomen provided with respiratory appendage formed of two setæ.

* Body oval, depressed.

Sub-genus *Nepa* FABR., LATR.

Sp. *Nepa cinerea* L., SWAMMERDAM, *Bibl. nat.* Tab. III. fig. 4; RŒSEL, *Ins.* III. Tab. 22; SCHELLENBERG, *Cimic.* Tab. XIV.; DUMÉR. *Cons. gén. s. l. Ins.* Pl. 37, fig. 2; *Waterscorpion*, very common with us in ditches and fish-ponds; the eggs, already described and figured by SWAMMERDAM, have seven threads at the end, which cause them to resemble the plumed seeds of Syngenistæ.

** Body slender, elongate.

Sub-genus *Ranatra* FABR., LATR.

Sp. *Nepa linearis* L., SWAMMERDAM, l. l. fig. 9; RŒSEL, *Ins.* III. Tab. 23, &c.; rarer than the former species.

II. Ocelli two.

*Galgulus* LATR. Ocelli two, frontal.

Sp. *Galgulus oculatus, Naucoris oculata* FABR., CUVIER, *R. Ani. éd. illust., Ins.* Pl. 93, fig. 4.

*Mononyx* LAPORTE.

*Pelogonus* LATR. Rostrum elongate, with sheath triarticulate, second joint long. Ocelli in vertex.

Sp. *Pelogonus marginatus* LATR., GERMAR, *Faun. Ins. Europ.* Fasc. XI. Tab. 23; CUV. *R. Ani. éd. ill.* Pl. 93, fig. 3; on the coasts of the south of France and of Spain. This genus makes the transition to *Salda*, but can scarcely, on account of the insertion and the shortness of the antennæ, be placed elsewhere than in this family.

Family XXXIX. *Geocorisæ* (*Aurocorisa* WESTW.). Antennæ exsert, longer than head, inserted towards the inner margin of eyes. Tarsi with three joints, with first joint very short in some. Rostrum often long, sometimes produced beyond the thorax.

Mostly terrestrial Hemiptera; few aquatic, living on the surface of the water, or inhabiting the banks.

*Land bugs.* This numerous family forms with LINNÆUS only one genus (*Cimex*), out of which, from the discovery of new forms and the more accurate distinction of the species formerly known, far more than 100 genera have already been formed by modern writers.

Phalanx I. *Oculata* (*Acanthiidæ* WESTW.) Sheath of rostrum triarticulate. Feet long, slender, terminated by two long claws. Antennæ quadriarticulate. Eyes large, protuberant. Ocelli two, in vertex. Head without distinct neck, separated by a small stricture from thorax.

*Salda* FABR., (in part) BURM., *Acanthia* LATR. Antennæ filiform, of the length of head and thorax.

Sp. *Salda littoralis* FABR. (and *Lygæus saltatorius* FABR.), *Cimex littoralis* L. (and *Cim. saltatorius* L.), DE GEER, *Mém.* III. Pl. 14, figs. 17, 18; WOLFF, *Wanzen*, Tab. VIII. fig. 74; this species leaps like a froth-cicada.

*Leptopus* LATR. Antennæ setaceous, nearly of the length of body, with third joint very long. Anterior feet spinose.

Sp. *Leptopus littoralis* LATR., CUV. *R. Ani. éd. ill.* Pl. 93, fig. 1, &c.

Phalanx II. *Hydrodromica.* (*Hydrometridæ* WESTW., *Ploteres* LATR.). Sheath of rostrum triarticulate. Head almost of the length of thorax, without distinct neck. Ocelli sometimes none. Four posterior feet longer than anterior, formed for going on the water, inserted at the sides of thorax, remote from each other. Head ovato-oblong or linear, covered beneath with a silky down.

Antennæ moderate, filiform, quadriarticulate, and either with a single accessory joint, very short between the second and third, or with three, interposed between each of the others. Tarsi with two or three joints, the last joint shortest.

A. Claws of tarsi inserted in a fissure at the inside before the extremity of last joint.

*Gerris* LATR., FABR. previously, *Hydrometra* FABR., BURM. (in part). Four posterior feet very long, remote from anterior. First joint of antennæ very long.

Sp. *Gerris lacustris, Cimex lacustris* L., STOLL, *Wantzen*, Tab. IX. fig. 63; DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 36, fig. 6. This species often continues wingless; comp. *Gerris canalium*, LÉON DUFOUR, *Anat. des Hémipt.* Pl. V. fig. 59;—*Gerris rufoscutellata* LATR., STOLL, l. l. Tab. 15, fig. 108; CUV. *R. Ani. éd. ill., Ins.* Pl. 92, fig. 5, &c.

*Halobates* ESCHSCH.

*Note.*—Species small, apterous, or with little elytra, with abdomen short, conical, in tropical seas and the Pacific; comp. ESCHSCHOLTZ, *Entomographien*, 1e Lieferung, Berlin, 1822, 8vo. pp. 106—111, Tab. III. figs. 3—5. Are they larvæ (and pupæ) of species of genus *Gerris?* Comp. the figure, much resembling a larva recently excluded from the egg, of LÉON DUFOUR, *Anat. d. Hémipt.* Pl. XV. f. 178.

*Velia* LATR. Feet sub-equally distant, the middle rather longer than the rest.

*Velia* WEST., BURM. First joint of antennæ longer than rest. Posterior femora incrassate, spinose.

Sp. *Velia rivulorum* LATR., *Gerris rivulorum* FABR., *Ent. Syst., Hydrometra rivulorum* FABR., *Syst. Rhyng.*, CUV. *R. Ani. éd. ill., Ins.* Pl. 92, fig. 4, &c.

*Hydroessa* BURM., *Microvelia* WESTW. Last joint of antennæ longer than rest.

Sp. *Velia pygmæa*, LÉON DUFOUR, &c.

B. Claws of tarsi apical.

*Hebrus* WESTW., BURM.

*Hydrometra* LATR. (species of *Hydrometra* FABR.), *Limnobates* BURM. Body narrow, elongate; head protracted beyond the eyes. Antennæ with third and fourth joints elongate, third very long. Feet very slender, long.

Sp. *Hydrometra stagnorum, Cimex stagnorum* L., SCHELLENB. *Cimic.* Tab. IX. fig. 2; DUMÉR. *Cons. gén. s. l. Ins.* Pl. 37, fig. 5. This small needle-shaped insect has much resemblance to the genus *Ploiaria*.

Phalanx III. *Nudicollia* (*Reduviidæ* WEST.). Sheath of rostrum triarticulate. Rostrum incurved. Head abruptly attenuated towards the base, forming a distinct neck. Antennæ with four joints, sometime annulate or divided into secondary joints. Feet long, with tarsi short, triarticulate, with two terminal claws.

A. Anterior feet raptorial, short, with coxæ elongate, thicker than thighs. (Four posterior feet very slender).

*Ploiaria* SCOPOLI, LATR. [*Gerris* FABR., BURM.], *Emesa* FABR., BURM. (and *Emesodema* SPINOLA, AMYOT). Antennæ longer than body, setaceous.

Sp. *Ploiaria vagabunda*, *Cimex vagabundus* L., SCHELLENBERG, *Cimic.* Tab. VIII.; CUVIER, *R. Ani. éd. ill., Ins.* Pl. 92, fig. 3; 2½‴ long, feet ringed, yellow-white, and black; this little creature has a staggering gait, like some long-legged gnats[1].

B. Anterior feet not raptorial, with coxæ short.

*Zelus* FABR. Body linear, with very long feet.

*Mycoris* BURM. Elytra entirely membranous. First joint of tarsi indistinct, almost entirely retracted upon the tibia.

*Reduvius* FABR. Body oblongo-oval.

Sub-genera: *Nabis* LATR., and *Reduvius* ejusd.

Sp. *Reduvius personatus* FABR., *Cimex personatus* L., DE GEER, *Mém.* III. Pl. 15, figs. 1—9; SCHELLENBERG, *Cimic.* Tab. VII. fig. 1; CUV. *R. Ani. éd. ill., Ins.* Pl. 92, fig. 1; black, nine lines long; the larva covered with dust and flue, coated as it were, lives in houses and feeds on insects;—*Reduvius amœnus* GUÉRIN (*Reduv. bullatus* Leyd. Mus.), GUÉR. *Iconogr., Ins.* Pl. 56, fig. 17; 1″. 1‴ long, abdomen vermilion red, concave above, cuticularly expanded with five black-blue round spots on each side; Java.

*Note.*—Many sub-genera of more recent authors have been omitted, on which comp. BURMEISTER (*Handb. der Entomol.* II. pp. 227—247), also AMYOT *et* SERVILLE (*Hist. nat. des Hémipt.* pp. 321—393; many of the names barbarous, taken from the tongues of Indians, Hebrews and Chinese).

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[1] There is a still smaller native species, about 1¾‴ long, which has darker wings, and the black rings on the feet broader than the yellow-white, *Ploiaria erratica*, *Gerris erraticus* KLUG, *Cimex culiciformis* DE GEER? III. Pl. 17, figs. 1—8. The genus *Ploiaria* was established by J. A. SCOPOLI in his *Deliciæ Floræ et Faunæ Insubricæ* (Ticini, 1786, folio), and indeed upon a wingless species from which the genus *Emesodema* was afterwards formed. This species, magnified, is several times figured in SCOPOLI'S work under the name of *Ploiaria domestica*, I. Tab. XXIV. figs. 1, 2, II. Tab. XXIII.; the *Ploioria alata* in the third part, Tab. XXV. fig. VI, figured by Count CASTILLIONE, agrees perfectly with the species noted by me as *Ploiaria erratica*. LESSON, in his *Illustrations de Zoologie*, Pl. 53, has figured, if I mistake not, the *Ploiaria domestica* of SCOPOLI under the name of *Ploiaria vagabunda*.

*Holoptilus.* LEPELETIER and SERV. Antennæ long, hirsute. Feet pilose, posterior tibiæ very hirsute. Tarsi large. Body depressed, with broad elytra.

Sp. *Holoptilus ursus* LEPEL., DE LAPORTE, GUÉR., *Magas. de Zool.* 1832, *Ins.* Pl. 54, fig. 1; CUV. *R. Ani., éd. ill., Ins.* Pl. 92, fig. 2. In the habitus this genus approaches to *Tingis.*

Sub-genus; *Ptilocnemus* WESTWOOD.

Phalanx IV. *Membranacea* (*Cimicidæ* and *Tingidæ* WESTW.). Sheath of rostrum triarticulate. Rostrum received in a sulcus beneath the head. Antennæ quadriarticulate. Tarsi with three joints or two. Body oval or suborbicular, depressed.

A. Antennæ setaceous, with last two joints slender.

*Acanthia* FABR., *Cimex* LATR.

Sp. *Cimex lectularius* L., DE GEER, *Mém.* III. Pl. 17, figs. 9–15; SCHELLENBERG, *Cimic.* Tab. VI. fig. 1; DUMÉR. *Cons. gén. s. l. Ins,* Pl. 37, fig. 2; *de weegluis, la punaise, die Bettwanze, the bug;* $2\frac{1}{2}'''$ long, wingless, brown-red, with short felty hairs, head small, thorax broad and short. This, too well-known, insect is able, according to the observations of DE GEER and LÉON DUFOUR, to live for a long time without food[1], and is not killed by the severest cold of winter, but revives on the first warmth from its torpor. This species would seem, according to SCOPOLI, also to occur winged; but here, in all probability, we have another species before us, which SCHILLING described as *Cimex domesticus* in 1833 (OKEN'S *Isis,* 1834, s. 738, 739[2]). There are still other species (wingless) on pigeons, bats and swallows, which JENYNS has described and figured; *Annals of Nat. Hist.* III. 1839, p. 241, Pl. 1.

B. Antennæ filiform or thicker towards the apex.

† Feet all similar, ambulatory.

*Aradus* FABR. Antennæ filiform.

Sp. *Aradus depressus* FABR., SCHELLENBERG, *Cimic.* Tab. V. fig. 2 (*Coreus spiniger*), WOLFF, *Wanzen,* Tab. XIII. fig. 123; lives under the bark of trees.

*Note.*—Here seems to belong the genus *Phlea* LATR.

*Tingis* FABR. Antennæ capitate.

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[1] LÉON DUFOUR found three bugs, which were enclosed in a glass, to continue alive without food for a whole year.

[2] A species of *Xylocoris* DUFOUR, according to BURMEISTER.

Sp. *Tingis echii* FABR., WOLFF, *Wanzen*, Tab. XIII. fig. 124, &c.; they live on leaves and flowers, and suck the sap of plants.

†† Anterior feet raptorial, with tibiæ incrassated, canaliculate beneath. Last joint of Antennæ incrassated.

*Syrtis* FABR.

Sub-genera; *Phymata* LATR., *Macrocephalus* SWED., LATR.

Sp. *Syrtis crassipes* FABR., PANZER, *Deutschl. Ins.* Heft 23, Tab. 24; CUV. *R. Ani., éd. ill., Ins.* Pl. 91, fig. 4;—*Syrtis erosa, Cimex erosus* L., WOLFF, *Wanzen*, Tab. IX. fig. 83; SULZER, *Kennz. der Ins.* Tab. XI. f. 71, &c.

On other sub-genera of this phalanx see the works cited above of BURMEISTER and AMYOT.

Phalanx V. *Longilabra.* Sheath of rostrum quadriarticulate. Labrum elongate. Antennæ with four or with five joints (in a few three). Tarsi with three distinct joints, terminated by two claws and two plantulæ (little membranous appendages).

A. Scutellum small or moderate, not produced as far as the middle of abdomen.

† Antennæ setaceous, with last joint very slender. (Ocelli none.)

*Capsus* nob. (*Capsus* and *Miris* FABR.)

*a*) First two joints of antennæ thick; second very long, equalling or surpassing in length the last two, which are very slender.

*Heterotoma* LATR.

Sp. *Capsus spissicornis* FABR., SCHELLENB. *Cimic.* Tab. III. fig. 4; PANZER, *Deutschl. Ins.* Heft II. Tab. 16; CUV. *R. Ani., éd. ill., Ins.* Pl. 91, fig. 3.

*b*) Second joint of antennæ incrassated at the apex only.

*Capsus* FABR. Thorax broader posteriorly.

*c*) Second joint of antennæ not incrassated.

*Miris* FABR., LATR. (*Miris, Phytocoris* FALL., BURM.) Thorax broader posteriorly, trapeziform.

*Astemma* LATR. (*Halticus* HAHN, BURM.) Thorax transversely quadrate.

†† Antennæ filiform or capitate.

*Lygæus* FABR.

*

Sub-genus: *Pyrrhochoris* FALL., BURM. Ocelli none.

Sp. *Lygæus apterus* FABR., *Cimex apterus* L., WOLFF, *Wanzen*, Tab. VI. fig. 102; STOLL, *Wantzen*, Pl. 15, fig. 103; $4\frac{1}{2}'''$ long, black with a red margin round the thorax, red shield-covers with a black point at the base, and a larger round spot of the same colour in the middle; the membranous portion of the shield-covers is very short; wings commonly wanting.

Sub-genera furnished with eyes: *Lygæus*, *Xylocoris* LÉON DUFOUR and others, on which comp. BURMEISTER, l. l. pp. 288—299.

*Coreus* FABR. Ocelli two. Body ovate or oblong. Antennæ straight.

Sub-genera: *Alydus* FABR., *Corizus* FALL. and others, for which see BURMEISTER, l. l. pp. 301, &c.

Sp. *Coreus quadratus* FABR., WOLFF, *Wanzen*, Tab. VII. fig. 67; HERRICH SCHÆFFER *Deutschl. Ins.* Heft 118, Tab. 12, &c.

*Leptocorisa* LATR. (*Gerris* in part; add *Berytus* FABR., *Neides* FABR.) Ocelli two. Body elongate, linear. Antennæ in some straight, in others broken.

Sp. *Berytus tipularius* FABR., *Cimex tipularius* L., DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 36, fig. 7; WOLFF, *Wanzen*, Tab. XX. fig. 198.

B. Scutellum large, produced as far as the middle of abdomen.

*Cimex* FABR. Antennæ mostly five-articulate (*Pentatoma* OLIV., LATR.), in some four-articulate (*Tesserotoma* LEPELET., SERV.)

*Note.*—The generic name *Cimex* I judged formerly, with LATREILLE, to be attributable to *Cimex lectularius*, according to the rule of LINNÆUS (*Phil. Botan.* § 246), which says that if a received genus is to be sub-divided, the previously common name ought to remain with the species most commonly known (species vulgatissima); but it seems advisable to give a received name to numerous species rather than to a few. Besides, a new name would be required, for that given by OLIVIER, *Pentatoma*, is inapplicable to several species of this genus, and the distinction taken from the number of joints of the antennæ is artificial, often severing affinities. For many genera of modern writers, not here recorded, see BURMEISTER, l. l. p. 347, &c., and AMYOT *et* SERVILLE, *Hémipt.* pp. 72—182.

Genera of FABRICIUS, *Cydnus*, *Halys*, *Edessa*, *Ælia*, *Cimex*.

Sp. *Cimex baccarum* L., PANZER, *Deutschl. Ins.* Heft 33, Tab. 18; WOLFF, *Wanzen*, Tab. VI. fig. 57; $4\frac{1}{2}'''$ long, the head and thorax red-brown with a shade of green, and many impressed minute black points; the scutellum yellow at the point, the abdomen black above with yellow spots at the

margin, yellow-brown below; on many plants in Holland, and common everywhere in Germany; I possess a specimen from the Cape of Good Hope little different.—*Cimex rufipes* L., WOLFF, *Wanzen*, Tab. I. fig. 9; RATZEBURG, *Forst-Ins.* III. Tab. XI. fig. 3; 6‴ long, the thorax with an ear-like process on each side, scutellum and feet red;—*Cimex acuminatus* L., *Ælia acuminata* FABR., PANZER, *Deutschl. Ins.* Heft 32, Tab. 17; WOLFF, *Wanzen*, Tab. II. fig. 19, &c.

C. Scutellum produced to the apex of abdomen, sometimes covering the wings entirely.

*Scutellera* LAM. (*Tetyra* FABR.)

For many genera of modern writers see BURMEISTER, l. l. pp. 382—396 and AMYOT *et* SERVILLE, l. l. pp. 25—77. Comp. also GERMAR in his *Zeitschr. f. Entom.* I. 1838, pp. 1—146, Tab. I.

*Pœcilocoris* (*Pœcilochroma* WHITE previously) DALLAS, *Sketch of the genus Pœcilocoris, Trans. of the Entomol. Soc. of London*, V. 1848, pp. 100—110, Pl. 13.

Genus *Canopus* FABR., with antennæ four-articulate, is not to be confounded with scutellera; the larvæ only are known, apterous, ocelli none.

Comp. J. W. DALMAN, *Ephemerides entom.* I. Holmiæ, 1824, 8vo. pp. 34—36, and *Lettre de M.* AL. DE LEFEBVRE *à M.* AUDINET SERVILLE *sur le Canopus obtectus de* FABR.; GUÉRIN, *Magas. de Zool.* 1835. *Ins.* Pl. 126.

## ORDER XI. *Orthoptera.*

Hexapod insects, with four wings, the upper coriaceous elytra, the lower membranous and folded in their length radiately like a fan. Mouth constructed for manducation, with strong mandibles; maxillæ furnished with galea cylindrical, vesicular (internal palp). Metamorphosis incomplete.

*Straight-winged.* OLIVIER first separated these insects under the name of *Orthoptera* from the order of the *Hemiptera* of LINNÆUS[1], and characterised this new order by the mode in which the under-wings are folded and by the presence of a galea on the lower jaws. In the oral parts they differ altogether from the *hemiptera*. But if we stand, not upon the name of the order, but upon the distinction

[1] *Encycl. méth., Hist. nat.* Tom. IV. *Insect.* Paris, 1789. *Introduction*, p. 16.

of it, then we cannot in any way look upon Olivier as its founder, because De Geer had already collected into a distinct division, to which he gave the name of *Dermaptera*, the self-same insects which are now arranged in the order of the *Orthoptera*. *Mém. pour servir à l'Hist. des Ins.* 1773, p. 309. He characterised these insects by their leathery shield-covers and the parts subservient to mastication[1].

Many orthopterous insects have two or three simple eyes. The antennæ always consist of a great number of joints. The left upper-jaw is on the whole more toothed than the right. The under-lip is divided into four lobes, of which the two exterior correspond with the galeæ of the under-jaws.

The first thoracic segment is generally large. Ordinarily there are four wings; sometimes, as in the mole-cricket and many species of *Phasma*, the anterior wings are very small, the posterior large; in *Phyllium*, on the contrary, the hind-wings are entirely absent, and there are only fore-wings or shield-covers; the instance of *Perlamorpha* Curtis is entirely peculiar, where shield-covers are wanting and hind-wings alone are present. The joints of the tarsus are in most fleshy or spongy beneath; the number of these joints is in every species the same for all the feet, and varies from three to five.

All the *Orthoptera* hitherto known are terrestrial, during the different states of metamorphosis. Some are carnivorous or omnivorous, but the greater number feed on plants. But some species often appear in great numbers and are very ravening, and may cause terrible devastation; this is especially the case with the locusts, a dreaded plague of the East.

The intestinal canal is on the whole short, and even in those species in which it has the greatest relative length, it is to the length of the body only as $1\frac{1}{2}$ or 2 : 1. The œsophagus has an expansion which may be considered as a crop or fore-stomach; this, in the mole-cricket, is situated quite laterally. The muscular stomach is small, orbicular, armed internally with horny teeth, which are arranged in six rows. Round the inferior orifice of this stomach are blind appendages of variable number; the genus *Acheta*, for instance, has only two such, *Gryllus* Fabr. (*Acrydium* Latr.) six, *Mantis* and *Blatta* eight. Of the numerous *vasa urinaria* in this order we have spoken above (p. 256), as also of the presence of

[1] Fabricius named these inse , *Ulonata*.

clustered salivary glands[1]. There are ten pairs of *stigmata*, two on the thorax and eight on the abdomen; the air-tubes are largely developed. In the species of the genus *Acridium*, which take such long flights, there are vesicular expansions in the abdomen in which the spiral thread is wanting. The nervous system consists of eight to ten ganglia, and the nervous cord in the abdomen is often somewhat bent or tortuous.

Comp. on this order C. Snoth, *Natuurkundige afbeeldingen en beschrijvingen der Spoken, wandelende Bladen, Zabelspringhanen enz.* Amsterdam 1787, en verv. 2 Deelen 4to.

Audinet Serville, *Hist. nat. des Insectes. Orthoptères.* Paris. 1839, av. Pl. 8vo. (a part of the *Suites à* Buffon, edited by Roret.)

For the anatomical peculiarities of this order, comp. Léon Dufour, *Rech. anatom. et physiol. sur les Orthoptères, les Hymenoptères, et les Neuroptères. Mém. présentés*, VII.

Besides the general works of Burmeister and Westwood, comp. also Brullé, in the work undertaken by him with Audouin, but not completed, *Hist. nat. des Insectes*, Paris, 1835. 8vo. Tom. IX. pp. 1—320. W. De Haan, *Bijdragen tot de kennis der Orthoptera* in the *Verhandelingen over de Natuurl. Geschied. der Nederl. overzeesche bezittingen*, Leiden, 1839—1844, folio. *Zoologie, Insecta*, bl. 45—248, and L. H. Fischer, *Orthoptera europæa. Accedunt tabulæ lapidi incisæ* 18. Lipsiæ, 1854. 4to.

Section I. *Saltatoria.* Posterior feet saltatory, with large thick thighs and tibiæ, armed on the posterior margin with a double row of spines. (The tibiæ are received in a furrow on the inferior surface of thighs, when folded forwards previous to leaping).

The insects of this division present, more strongly than those of the following, the *types* of the order.

The production of a sound or song is peculiar to species only of this division[2]. As in the *Cicadæ*, so here it is only the males that produce the sound.

Amongst the numerous writers on this subject, it may suffice to refer to the work of Goreau, illustrated by many figures; *Essai sur la stridulation des Insectes, Annal. de la Soc. Entomol. de France*, VI, 1837, pp. 33—75.

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[1] Léon Dufour informs us, incorrectly, that the salivary glands in the *Orthoptera* were unnoticed until by himself, *Mém. prés.* VII. p. 297. But long previously, G. R. Treviranus had observed these parts in *Blatta* (*Biologie*, IV. s. 323, 324), whose opinion, that they occur in this genus of the order alone, was abundantly refuted by J. F. Meckel, who found them also in *Mantis*, *Phasma*, *Acheta* and *Locusta*, though less developed than in *Blatta*. *System der vergleich. Anat.* IV. s. 118, 119.

[2] Hence to the *Orthoptera* of this first division the name of *Stridulantia* might be given, to the second that of *Muta*.

Family XL. *Gryllides* nob. (Genus *Gryllus* L.) The characters of the section are also those of the single family.

A. Elytra and wings deflected.

Phalanx I. *Acridii*. Antennæ filiform or subclavate, sometimes depressed, acuminate towards the apex, mostly short or moderate (not longer than half the body), with six to twenty-five joints. Ocelli three. Tarsi with three joints.

* Leach and Westwood (see *Introduction to modern Classif. of Ins.* Westw. I. p. 438) name the insects of this group *Locustidæ*, because Linnæus had named the sub-division of his genus *Gryllus*, to which the common grasshopper belongs, and which in great measure composes the present division, *Locusta*. It would certainly have been better if Geoffroy had not given the name *Locusta* to the sabred-grasshopper with long filiform antennæ (*Gryllus viridissimus* L., &c.). But now that this generic name has been adopted by Fabricius, Latreille and all subsequent writers, we think that a change of signification would rather increase than diminish the confusion of which the above-named English authors complain.

The three simple eyes are placed in a triangle; the two lateral, between the compound eyes and the antennæ, in the middle and sometimes quite on that surface of the head which is directed downwards.

Of the three joints of the tarsus the first is long and appears to consist of three joints that have coalesced; so that to these insects perhaps might very properly be ascribed five joints in the tarsus, as by Latreille in his *Familles natur. du Règne animal*, and by ourselves in imitation of him in the first edition of this Handbook.

The sound produced by these insects is caused by a rapid friction of the thighs of the hind-feet against the shield-covers; here the feet act like the bow of a violin. The first abdominal segment is mostly furnished with a drum on each side, distinguished externally by a circular or lunated membranous cover. Behind this membrane is situated a small vesicle filled with fluid, and behind this again a large air-tube vesicle. Whilst some recognise in this an instrument for sound, like that of the *Cicadæ*, J. Müller and V. Siebold consider it to be an auditory apparatus; see above pp. 282, 283.

The borer for laying eggs does not project much, it consists of four curved pieces. The eggs are mostly enveloped in a common covering, adhering to each other by a tenacious frothy matter, and in many species hidden beneath the earth.

I. Posterior feet longer than body.

*Tetrix* LATR., *Acrydium* FABR. Antennæ short, with thirteen to fifteen joints. Prothorax receiving a part of the head and covering the oral organs. Pronotum produced into a scutellum above the abdomen, sometimes beyond the abdomen. Plantula between the claws of tarsi none.

Sp. *Tetrix bipunctata, Acrydium bipunctatum* FABR., *Gryllus bipunctatus* L., DE GEER, III. Pl. 23, fig. 15 (magnified), DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 25, fig. 5, &c. ZETTERSTEDT adopts different species here, which appear to be only varieties. Comp. on this species (whose scutellum is not longer than the abdomen) and *Tetrix subulata* (whose scutellum extends with its apex behind the abdomen) PHILIPPI *Orthoptera Berolinensia* (Berolini, 1830, 4to), pp. 41, 42.

Add genus *Amorphopus* SERV., imperfectly known, and *Hymanôtes* WESTW., *Choriphyllum* SERVILLE, with dorsum compressed into a foliaceous crest erect above the body; habit of *Membracis*, SERVILLE, l. l. Pl. 8, fig. 5.

*Gryllus* FABR., *Acridium* LATR. Antennæ of length of head and thorax, with about twenty (twenty to twenty-four) joints. Anterior extremity of prosternum not covering mouth. Plantula, or pulvillus between the claws of tarsi.

*Note.*—LATREILLE conjoined in sub-genus *Podisma*, species of which the elytra and wings are short and unfit for flight. As FABRICIUS had previously written the genus *Acrydium* incorrectly, so also LATREILLE called it *Acrydium*, whom many imitated. It is, however, 'Ακρίδιον; and I would willingly have rejected the diminutive form, and have given the name *Acris* to the genus, since large, and even the largest species are contained in it. It appeared, however, more advisable to give the name of *Gryllus* to this the largest portion of the old Linnæan genus of the same name.

*Gryllus* FABR. Antennæ filiform or clavate. [Here belong genera *Ommexecha* SERV. (not BRULLÉ), *Gomphocerus* THUNB., *Œdipoda* LATR., *Oxya* SERVILLE, *Monachidium* ejusd. and some others; on which comp. BURMEISTER, *Handb.* II. 2, 1838, pp. 602, &c., and SERVILLE, *Hist. n. des Orthopt.*]

Sp. *Gryllus migratorius* L., RŒSEL, *Ins.* II. *Locust.* XXIV.; BLUMENBACH, *Abbild. naturk. Gegenst.* No. 29; the thorax obtusely carinated, the jaws bluish black. This insect is found in different regions of Europe and Asia, and appears sometimes in great swarms, destroying everything on its road. See on the devastations caused by this and other grasshoppers, KIRBY and SPENCE, *Introd. to Entomol.* II. pp. 215—226; RITTER'S *Erdkunde* also contains many relations on that matter from different parts of Asia. In

the year 1748 such a sort of all-destroying locusts spread itself over the west of Europe, to the Netherlands, nay even to England. That they are able to cross the sea, is placed beyond doubt by many accounts, according to which people on ship-board, many miles from land, observed the swarms. Some districts of the South of France are frequently damaged for several years in succession by different species of grasshoppers, for the collection of which large sums of money are sometimes bestowed. In 1824 at *Saintes-Maries*, in the neighbourhood of *Marseilles*, 1518 corn-sacks were filled with grasshoppers, and at *Arles* 165 sacks; the expense amounted to 5542 fr.; in 1833, in the first-mentioned place, 3808 kilogrammes of eggs of these creatures were collected; the number of eggs that make up a kilogramme may be computed at about 80,000. (See *Ann. de la Soc. Entom. de France*, II. 1833, pp. 486—489; these observations refer, however, to other species than *Gryllus migratorius*.) Different large species are eaten by people of the East, as, for instance, *Gryllus cristatus* L., RŒSEL, l. l. Tab. V. Already in Pliny examples are met with of locust-eating nations (*Hist. nat.* Lib. VI. c. 30 *in fine*, Lib. XI. c. 29 *in fine*), not to speak of more modern accounts (ADANSON, *Hist. de Senegal*, pp. 88, 89, SALT, *Voyage to Abyssinia*, London, 1814, p. 172).

*Gryllus cœrulescens* L., RŒSEL, l. l. Tab. XI. fig. 4, DUMÉRIL, *Cons. gén. s. d. Ins.* Pl. 29, figs. 3, 4; thorax obtusely carinated, elytra brown-grey with darker streaks, wings blue, at the point white, with a broad, black margin.

*Gryllus biguttatus* CHARPENT., *Gryllus biguttulus* PANZER (not L.), PANZ. *Deutschl. Ins.* Heft 33, Tab. 6, GERMAR, *Faun. Ins. Europ.* Fasc. XX. Tab. 22, 23, one of the smallest species of this genus, only 5‴ long; the male has knobbed antennæ, &c.

*Phymateus* THUNB., SERVILLE. Antennæ thick, longer than head and thorax, with joints distinct, the last longer, acuminate towards the apex. Plantula large, orbicular between the claws of tarsi. (Ocelli little distinct or none.)

Sp. *Gryllus morbillosus* L., RŒSEL, *Ins.* II. *Locust.* Tab. 18, fig. 6, STOLL, Pl. II. b, figs. 3, 4, from the Cape of Good Hope.

Add sub-genera *Petasia* SERV., *Pœcilocera* ejusd., *Rhomalea* ejusd., and some others, here omitted.

*Xiphicera* LAM., LATR. (*Xiphocera* BURM.) Antennæ depressed, lanceolate or ensiform. Frons produced into a cone. Other characters as in *Grylli*.

Sp. *Xiphic. serrata*, *Gryllus serratus* L., DE GEER, *Mém.* III. Pl. 42, fig. 2, Pl. 41, fig. 6; RŒSEL, II. *Loc.* Tab. 16, fig. 2, STOLL, Pl. 19 b, fig. 71, Pl. 21, fig. 81;—*Xiphic. emarginata*, SERV., RŒSEL, l. l. fig. 3, CUV. *R. Ani. éd. ill.* Pl. 85, fig. 2.

Add genus *Trigonopteryx* CHARPENT.

*Truxalis* FABR. (*Gryllus Acrida* L.). Antennæ depressed, ensiform. Head conical, longer than thorax. Body elongate. Elytra narrow. Posterior feet very long, with tibia elongate, slender.

Sp. *Truxalis nasutus* FABR., *Gryllus nasutus* L., RŒSEL, *Ins.* II. *Locust. ind.* Tab. v. (antennæ badly drawn); DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 24, fig. 3; CUVIER, *R. Ani. éd. illustr. Ins.* Pl. 84, fig. 8, in south of Europe and in Africa;—*Trux. variabilis*, KLUG, and others, very similar species; both the above-named species are also found at the Cape of Good Hope, the first also at Japan; see DE HAAN, *op. cit.* pp. 141, 142. Comp. on this genus THUNBERG, *Nov. Act. Soc. Upsaliens*, IX. 1827, pp. 76—88.

*Proscopia* KLUG. Body elongate, apterous. Head elongate, pyramidal, produced beyond the eyes; antennæ subulate, very short, with six or seven joints. Prothorax very long.

Sp. *Proscopia radula* KLUG, CUV. *R. Ani. éd. ill. Ins.* Pl. 85, fig. 1, from Brazil, like most of the species (all from America). These animals resemble *Phasma* in the *habitus*, and *Mantis* in the long *prothorax*. I cannot perceive a groove on the thighs for the reception of the tibiæ[1].

II. Posterior feet shorter than body.

*Pneumora* THUNB. Antennæ filiform, with twenty-one to twenty-five joints. Head short, with eyes remote. Prothorax produced into a membranous scutellum; thorax short. Abdomen in males inflated or vesicular. Greatest part of elytra incumbent horizontally on the back. Elytra and wings short in females; in some almost quite obsolete, covered by scutellum.

Sp. *Pneumora variolosa*, LATR., *Gryllus variolosus*, L., FABR., *Pneumora marmorata*, THUNB., STOLL, Pl. 20, fig. 78; CUVIER, *R. Ani. éd. ill., Ins.* Pl. 84, fig. 1; from the Cape of Good Hope. The other species also of this genus belong to the south of Africa.

Phalanx II. *Locustariæ*. Antennæ setaceous, long (often longer than body), with joints numerous. Ocelli in most none. Tarsi with four joints. Females furnished with ovipositor bivalve, ensiform. In males the right, or more rarely both elytra, mostly furnished with a basal portion, orbicular, transparent (musical organ).

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[1] CHARPENTIER records a winged species from Chili. Elytra were not present; wings very small; but what seems most to distinguish this species is the absence of a *pulvillus* or *plantula* on the *tarsus*. Hence it might form a distinct genus *Astroma* (CHARP.) GERMAR'S *Zeitschr.* III. 1841, s. 305.

*Sabre-grasshoppers*, with LINNÆUS *Grylli Tettigoniæ*, *Syst. Nat. ed.* XII. 1, p. 695; the name of *Tettigoniæ*, however, is rightly given by later writers to the *Cicadæ*.

In many species the tibiæ of the fore-feet have two oval apertures covered by a tense membrane (see above, p. 283); comp. also LANSDOWN GUILDING, *Transact. of the Linnæan Society*, XV. 1827, pp. 153—155.

The wings are in some very short or entirely wanting (*Hetrodes*, some species of *Bradyporus*, *Saga*, &c.)

*Locusta* GEOFFROY, FABR., LATR.

Sub-genera: *Bradyporus* CHARPENT., *Hetrodes* FISCH., *Ephippigera* LATR., *Barbitistes* CHARPENT., *Meconema* SERV., *Acridopeza* GUÉR., BURM., *Pomatonota* BURM., *Mecopoda* SERV., *Scaphura* KIRBY (and *Gymnocera* BRULLÉ), *Phaneroptera* LATR., SERV., *Phylloptera* BURM. (*Phylloptera*, *Ancylecha*, *Steirodon* SERV.), *Phyllophora* THUNB., *Hyperomala* SERV., *Aspidonotus* BRULLÉ, *Pterochroza* SERV., *Cyrtophyllus* BURM., *Pseudophyllus* SERV., *Aprion* SERV., *Thliboscelis* SERV. (*Platyphyllus* BURM.), *Meroncidius* SERV., *Acanthodis* SERV., BURM. (and *Platyphyllus* SERV.), *Copiophora* SERV., *Pseudorynchus* SERV., *Conocephalus* THUNB., *Agræcia* SERV., *Xiphidium* BURM. (*Xiphidium* SERV. and *Orchelimum* ejusd.), *Bucrates* BURM., *Decticus* SERV., BURM., *Locusta* SERV. (*Phasgonura* WESTW.), *Listroscelis* SERV., *Saga* CHARPENT., *Schizodactylus* BRULLÉ (*Acheta* BURM.), *Stenopelmatus* BURM., *Raphidophora* SERV. (*Phalangopsis* BURM. in part).

Sp. *Locusta pupa*, *Gryllus pupus* L. (*Heterodes pupa*, FISCH.), STOLL, *Locust.* Pl. XII. a, fig. 45, 46; RŒSEL, *Ins.* II. *Locust.* Tab. VI. fig. 3; DE GEER, *Mém.* III. Pl. 39, fig. 5; wingless, thorax and abdomen armed with spines. From the Cape of Good Hope.

*Locusta viridissima* FABR., *Gryllus viridissimus* L., RŒSEL, *Ins.* II. *Locust.* Tab. X. XI.; PANZER, *Deutschl. Ins.* Heft 89, Tab. 18, 19, DUMÉR. *Cons. gén. s. l. Ins.* Pl. 24, fig. 1; green, without spots, with green shield-covers, and very long antennæ. This species is not rare with us on pastures, in gardens, &c. The eggs laid in autumn, pass the winter, and the grasshoppers come forth from them in May or later. After the third moult they shew rudiments of wings and shield-covers (in July); towards the end of August they moult for the last time, and become perfect insects. The copulation is repeated a few times, and the eggs are placed in the earth by the female by means of her sabre-shaped ovipositor, not all at once, but at intervals in different places. These grasshoppers die towards the end of autumn.—*Locusta verrucivora* FABR., *Gryllus verrucivorus* L., RŒSEL, *Ins.* II. *Locust.* Tab. VIII. IX. PANZER, l. l. Tab. 20, 21; this is somewhat smaller, has shorter antennæ, and brown

spots on the green elytra. The Swedish peasants put this insect, according to LINNÆUS, upon their hands to bite off the warts.—*Locusta varia* FABR., *Meconema varia* SERVILLE, PANZER, *Deutschl. Ins.* Heft 33, Tab. 1, &c.

B. Elytra and wings horizontal, for the most part incumbent on back.

Phalanx III. *Achetidæ* (*Gryllides* LATR.). Labium with four laciniæ. Tarsi triarticulate, with joints slender, sometimes spinose.

The *Crickets, gravende sprinkhanen* (*Grabheuschreken*) live underground or in holes, and are mostly nocturnal. They form with LINNÆUS the division *Acheta* of the genus *Gryllus*, or the genus *Gryllus* of GEOFFROY and OLIVIER and the genus *Acheta* of FABRICIUS.

*Myrmecophila* LATR., *Sphærium* CHARPENT., BURM. Antennæ setaceous, long. Head covered by prothorax. Ocelli none. Elytra and wings none. Females with ovipositor exsert, bifid. Anterior feet gressorial, posterior with thighs thick, very broad.

Sp. *Myrmecophila acervorum, Blatta acervorum,* PANZER, *Deutschl. Ins.* Heft 68, Tab. 24; GUÉRIN, *Iconogr. Ins.* Pl. 54, fig. 6; CUVIER, *R. Ani. éd. ill., Ins.* Pl. 84, fig. 2.

*Acheta* FABR. (in part), *Gryllus* LATR. Anterior feet gressorial. Antennæ setaceous, long. Ocelli mostly obsolete or none. Elytra short, and in most two wings longer. Females provided with ovipositor exsert.

*a*) Pronotum transverse or quadrate.

Sub-genus: *Acheta* nob. (*Platyblemus* SERV., *Brachytrupes* SERV., *Gryllus* SERV., *Nemobius* SERV., *Trigonidium* SERV., *Podoscirtus* SERVILLE, *Scleropterus* HAGENB., *Eneoptera* BURM.)

Sp. *Acheta domestica* FABR., *Gryllus domesticus* L., RŒSEL, *Ins.* II. *Locust.* Tab. XII.; PANZER, *Deutschl. Ins.* Heft 88, Tab. 6, 7; CUV. *R. Ani. éd. ill., Ins.* Pl. 81, fig. 4; the *hearth-cricket;* body yellow-brown, wings longer than shield-covers, terminate in a tail-like point. These animals live near the hearth and under stoves in an artificially warm climate, and chirp of an evening or by night, and especially when it is about to rain; the sound caused by the friction of the shield-covers is in a very high note, which some persons, otherwise not deaf, cannot perceive.

*Acheta campestris* FABR., *Gryllus campestris* L., RŒSEL, l. l. Tab. XIII. PANZ. *Deutschl. Ins.* Heft 88, Tab. 8, 9, CUV. l. l. fig. 3; the *field-cricket.* This species is larger than the preceding, has longer shield-covers and a

black body, without the elongated point at the wings, which in the preceding species extends behind the elytra.

*Note.—Eneoptera* BURM. (*Platydactylus* BRULLÉ and SERVILLE in part). The generic name devised by BURMEISTER on account of the elytra similar in both sexes of some species, having no musical organ in males; comp. BURMEISTER, *Handb. der Entomol.* II. 2, p. 1015, and on the typical species, DE HAAN, l. l. p. 231. The name of *Platydactylus* ought to be rejected, since given long previously to a genus of Saurians. In these *Achetæ* the body is elongate, posterior feet very long; ovipositor of females long, recurved upwards, with valves divergent, clavate at apex. Sp. *Acheta brasiliensis* FABR., *Gryllus surinamensis* DE GEER, *Mém.* III. Pl. 43, fig. 1, GUÉRIN, *Iconogr., Ins.* Pl. 54, fig. 1, (named *Gryllus Servillei*).

*b*) Pronotum oblong, narrower forwards.

*Phalangopsis* SERVILLE. Feet elongate. Elytra short; wings none, or very short rudiments of wings.

Sp. *Phalangopsis longipes* SERVILLE, *Hist. nat. des Orthopt.*, Pl. 12, fig. 1. Habit. in South America.

*Œcanthus* SERVILLE. Feet elongate. Elytra and wings long.

Sp. *Acheta italica* FABR., *Œcanthus pellucens* SERVILLE, PANZER, *Deutschl. Ins.* Heft 22, Tab. 17.

*Note.*—BRULLÉ and SERVILLE assign four joints of tarsi in posterior feet to these insects, which BURMEISTER has shewn to be an error, *Handb. der Entomol.* II. 2, p. 731.

*Gryllotalpa* LATR. (species of *Acheta* FABR.). Anterior feet fossorial, compressed, broad. Antennæ setaceous, shorter than body. Ocelli two, placed between the compound eyes. Pronotum elongate, oval, gibbous; ovipositor of female none.

Sp. *Gryllotalpa vulgaris, Gryllus Gryllotalpa* L., RŒSEL, *Ins.* II. *Locust.* Tab. XIV. XV.; DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 25, fig. 7; *the mole-cricket*, 1½" long, brownish-black, yellow below, with grey-brown, darker-veined shield-covers. The fore-feet work like saws, or as spades, with which these insects burrow the ground. The female lays her eggs in a hole under ground, to which a long curved passage leads, in and out of which she often creeps; at first the young ones live close together, but soon disperse. Horse-dung appears to attract these animals, swine-dung to repel them. They live especially in garden-mould and turfy bog. On the anatomy see KIDD, *Philos. Trans.* 1825, Part II. pp. 203—246, and my *Anteekeningen over het inwendig maaksel des veenmols, Bijdragen tot de natuurk. Wetensch.* V. 1830, bl. 94—102. This species is spread throughout the whole of Europe and of Asia, and other species of this genus are found in all parts of the world.

*Cylindrodes* GRAY, SERVILLE. Body elongate. Vestiges alone of wings and of elytra. Feet short, with tarsi didactylous.

*Xya* ILLIG. (*Tridactylus* OLIV., LATR.) Anterior feet fossorial. Antennæ short, filiform, with ten joints. Ocelli three. Posterior feet elongate, saltatory, terminated by lamellæ in place of tarsi.

*Xya* ILLIG. Posterior tibiæ furnished with lamellæ elongate, lanceolate, depressed.

Sp. *Xya fossor* BURM., *Tridactylus paradoxus* LATR.; DUMÉR. *Cons. gén. s. l. Ins.* Pl. 25, fig. 8; GUÉRIN, *Iconogr. Ins.* Pl. 54, fig. 5. Hab. in Africa. *Xya variegata* ILLIG., BURM., CUVIER, *R. Ani. éd. ill., Ins.* Pl. 81, fig. 2. Hab. in south of France and in Spain. LÉON DUFOUR is of opinion that it belongs to the *Acridii*; comp. his *Recherches sur l'Hist. nat. du Tridactyle panaché, Ann. des Sc. nat.* 2e Série, Tom. IX. 1838, pp. 321—334.

Sub-genus: *Rhipipteryx* NEWMAN, BRULLÉ (species of *Xya* BURM., *Rhipidopteryx*). Posterior tibiæ destitute of lanceolate lamellæ.

Section II. *Cursoria.* Feet ambulatory alone. Wings and elytra horizontal, incumbent. (Musical organ present in none.)

Family XLI. *Mantides* nob. (genus *Mantis* L.) Tarsi with five joints. Head not covered by thorax.

Phalanx I. *Spectra* (*Phasmida* LEACH. *Phasmodea* BURM.). Fore-feet similar to the rest, not raptorial, very near the head, remote from the intermediate pair. Antennæ mostly setaceous, long, in a few short, filiform. Labrum deeply bifid. Mandibles thick, strong; maxillæ hard at the apex, subdenticulate; galea plane, broad. Labium quadrifid, with laciniæ unequal, the external very long, plane, hatchet-shaped. Elytra almost always short, wings large; sometimes wings and elytra none.

*Phasma* LICHTENST., FABR. (*Spectrum* STOLL).

These insects are in great part confined to tropical countries; many also are found in New Holland. They live on vegetable food. Some wingless species have the form of dried twigs, and others, which are flat, with membranous and vein shield-covers, have a great resemblance to leaves (the genus *Phyllium.*) Of some species the males are much smaller than the females; the former have often three simple eyes, which in the last are absent. In this division the largest species of insects are found.

Comp. A. A. H. LICHTENSTEIN, *Dissert. on two nat. genera hitherto confounded under the name of Mantis; Trans. of the Linnæan Soc.* VI. 1802; TOUSSAINT VON CHARPENTIER'S *Bemerkungen zu* LICHTENSTEIN'S *Abh.*

*üb. die Mantis-Arten*, in GERMAR'S *Zeitschr. f. d. Entom.* v. 1844, s. 272—311.

G. R. GRAY, *Synopsis of the species of Insects belonging to the family of Phasmidæ*, London, 1835, 8vo; and his *Entomology of Australia*, Part I. *Monogr. of the gen. Phasma*, London, 1833, 4to, with 8 col. pl.

*Phasma* FABR. (Species of genus *Phasma* LICHTENST.) Body elongate. Mesothorax often very long.

*a*) Feet cylindrical or angulate, prismatic.

* *Both sexes apterous.*

*Bacillus* LATR. Antennæ short (of length of head), filiform or conical.

Sp. *Phasma Rossia* FABR., *Suppl. Entom. syst.* (1798) p. 187; P. ROSSI, *Fauna Etrusca*, Liburni, 1790, Tab. VIII. fig. 1; CUV. *R. Ani. éd. ill., Ins.* Pl. 79, fig. 2; BRULLÉ, *Hist. nat. d'Ins.* IX. Pl. 9, fig. 2;—*Phasma tripolitanum*, DE HAAN, l. l. Tab. XV. fig. 3.

*Bacteria* LATR. Antennæ setaceous, longer than head and prothorax.

Sp. *Phasma ferula* FABR., *Bacteria arumatia* GRAY, RŒSEL, *Ins.* II. *Locust. Ind.* Tab. XIX. fig. 10; STOLL, *Spectr.* Pl. 13, fig. 51; *Bacteria sarmentosa* WESTW., *Cabinet of Oriental Entom.* 1847, Pl. 32, fig. 1, &c.

*Note.*—For several other sub-genera see BURMEISTER, l. l. pp. 568—610, and SERVILLE, l. l.

** *Male winged, female apterous.* (Antennæ setaceous, long.)

*Cladoxerus* SERVILLE. (*Cladomorphus* GRAY fem.)

Add sub-genus *Monandroptera* SERVILLE, l. l. p. 244.

*** *Both sexes winged.* (Antennæ setaceous, mostly long, in females of some species shorter).

*Phasma* nob.

Sp. *Phasma gigas* F., *Mantis gigas* L., STOLL, *Spectr.* Tab. II. fig. 5; CUV. *R. Ani. éd. ill., Ins.* Pl. 80, fig. 1; DE HAAN, l. l. Pl. 14, fig. 3. From the Molucca Islands and Java.

*Note.*—Here belong very many genera of modern authors, *Diapherodes* GRAY, *Haplopus* GRAY, BURM., *Cyphocrania* SERV., BURM., *Necroscia* SERV.

*Aschiphasma* WESTW. (*Perlamorpha* CURTIS, SERV.) is distinguished by elytra none or very small, spiniform, with wings ample and anterior margin obscure. DE HAAN records many species from the islands of Java and Borneo, *op. cit.* pp. 113—116.

*b*) Feet winged or foliaceous.

Sub-genera: *Tropidoderus* GRAY, *Ectatosoma* GRAY, *Prisopus* SERV., GRAY.

Sp. *Prisopus flabelliformis* GRAY, *Phasma dracunculus* LICHTENST., STOLL, *Spectr.* Pl. 18, fig. 65, from Surinam. *Prisop. Horstokii* DE HAAN, l. l. Tab. 12, fig. 1; hab. Cape of Good Hope. In the shorter body and entire habit they somewhat approach the genus *Phyllium*.

*Phyllium* ILLIG. (species of genus *Mantis* L. and FABR., species of *Phasma* LICHTENST.) Abdomen oval, depressed. Prothorax scarcely longer than mesothorax, sub-triangular, posteriorly narrower. Antennæ of males setaceous, pilose; of females very short, filiform. Elytra short and wings long in males; in females elytra large, membranous covering abdomen, wings very small. Thighs dilated, alate.

Sp. *Phyllium siccifolium, Mantis siccifolia* L., FABR., RŒS., *Ins.* II. *Loc. ind.* Tab. XVII. f. 4, 5; STOLL, *Spectr.* Pl. VII. f. 24, 26; DUMÉR. *Cons. gén. s. l. Ins.* Pl. 23, fig. 2 fem. &c.; the *walking-leaf*. This species is extended from the Sechelles over Java and Timor to New-Guinea. Some allied species are from the same regions and from China; none are known from the new world.

Phalanx II. *Mantides*. Anterior feet raptorial, with coxæ long and femora compressed, receiving the tibia beneath. Prothorax not shorter than mesothorax, mostly exceeding the mesothorax in length. Ocelli three. Antennæ mostly setaceous, moderate. Labrum entire, orbicular. Labium quadrifid, with laciniæ equal. Elytra and wings in all.

The anterior feet are situated close to the head, and are much stronger than the rest, usually very thin; they have large compressed thighs which are armed beneath with teeth or spines, and have a channel in which the tibiæ can be lodged like a clasp-knife. With these fore-feet bent together and with head on high, these insects often sit long in an immoveable position. Hence the eastern people say that they are at prayers, and moreover, like true Mahometans, with the face and hands turned towards Mecca. With this pious deportment however, and the superstitious reverence which is in consequence conferred on these insects by different nations, their cruel worldliness is at variance; they live on other insects, and also mutually devour one another. See BLUMENBACH, *Abbild. natur-historischer Gegenstände*, No. 88.

STOLL gives to these insects the name of *walking-leaves*, by which however is usually understood the preceding genus *Phyllium*.

*Mantis* L. (in part), FABR. (exclus. *Mant. siccifolia*).

a) *Antennæ of males pectinate, of females setaceous. Head produced upwards into a horn.*

*Empusa* ILLIG.

Sp. *Mantis gongylodes* L. and FABR. (fem. *Mantis flabellicornis* FABR. male); RŒSEL, *Ins.* II. *Locust.* Tab. VII.; STOLL, *Spectr.* Pl. 16, figs. 58, 59. Pl. 17, fig. 61; Bengal, Ceylon;—*Mantis pauperata* FABR., CUV. *R. Ani. éd. ill., Ins.* Pl. 78, fig. 2; south of Europe, north of Africa, &c.

Sub-genus *Blepharis* SERV.

b) Antennæ in both sexes simple; head very often transverse, broad.

*Mantis* ILLIG.

Sp. *Mantis religiosa* L., RŒSEL, *Ins.* II. *Locust.* Tab. I. II. Tom. IV. Tab. XII.; PANZER, *Deutschl. Ins.* Heft 50, Tab. 8; CUV. *R. Ani. éd. ill., Ins.* Pl. 78, fig. 1; in south of Germany, in France, and other parts of the south of Europe, and also in Africa;—*Mantis oratoria* L., *Mantis bella* SALZMAN, GERMAR, *Faun. Ins. Europ.* Fasc. VI. Tab. 16, South of Europe, &c.

*Note.*—Several sub-genera, founded on the form of the prothorax, the eyes, the feet, and other characters, are recorded by SERVILLE and BURMEISTER, not always well defined: *Eremophila* BURM. (*Eremiaphila* LEFEB.), *Metalleutica* WESTW., *Chæteessa* BURM., *Tarachodes* BURM., *Theoclytes* SERV. (*Vates* BURM.), *Harpax* SERV., *Acanthops* SERV., *Schizocephala* SERV., and others; for which consult the authors cited above.

*Mantis strumaria* L. (RŒSEL, *Ins.* II. *Locust.* Tab. III.), and similar species with prothorax dilated, partly covering head, form the transition to the *Blattæ*.

Family XLII. *Blattariæ*. Tarsi with five joints. Head inferior, covered by prothorax clypeiform.

*Blatta* L. Body oval or orbicular, depressed. Antennæ long, setaceous. Ocelli obsolete. Maxillary palps elongate, with last joint hatchet-shaped. Feet all similar, long, tibiæ provided with spinules moveable. Abdomen posteriorly supplied with two appendages conical, articulate.

a) *Each sex apterous.*

Sub-genus: *Polyzosteria* BURM. (Species of *Blatta* SERV.)

b) *Male winged, female apterous.*

Sub-genera: *Perisphœria* SERV., BURM., *Heterogamia* BURM. (Species of *Blatta* SERVILLE.)

c) *Each sex winged.*

*Corydia* SERV., BURM. Elytra horny, with veins indistinct (add *Phoraspis* SERV., BURM.)

Sp. *Blatta Petiveriana* FABR., *Cassida Petiveriana* L., STOLL, *Blatt.* Tab. v. d. figs. 21, 22, *Blatta heteroclita* PALLAS, *Spic. Zool.* IX. Tab. I, fig. 5, &c.

Sub-genus: *Blatta* nob. Elytra coriaceous, with veins eminent; posterior wings shorter, not reflected at apex.

*Note.*—Here belong several sub-genera of BURMEISTER and SERVILLE: *Thyrsocera* BURM. (*Pseudomops* SERV.), *Ischnoptera* BURM., *Nyctibora* BURM. (species of *Blatta* SERV.), *Periplaneta* (*Kakerlac* LATR., SERV.), *Epilampra*, *Panchlora*, *Nauphœta*, *Proscratea*, *Zetobora* BURM., *Hormetica* BURM. (*Brachycola* SERV.), *Panesthia* SERV., BURM., *Blabera* SERV., BURM., (and *Monachoda* BURM.)

Sp. *Blatta orientalis* L., *Periplaneta orientalis* BURM., DE GEER, *Ins.* III. Tab. 25, fig. 1; PANZER, *Deutschl. Ins.* Heft 96, Tab. 12; *gemeene kakerlak, gemeine Pfisterschabe, Blatte des cuisines; Blatta laponica* L., PANZER, ib. Tab. 13, &c.

The *Kakerlacs* are nocturnal. They are great devourers, and gnaw even leather, shoes, &c. The name *Blatta* (from βλάπτειν, to injure) occurs already amongst the ancients; yet probably it signified other insects. The female lays her eggs heaped into separate little masses distributed in cells; see GŒZE, *Naturforscher*, XVII. s. 183—189, Tab. IV. figs. 16—19. RATHKE has communicated his observations on the development in the egg in *Blatta germanica* in *Meckel's Archiv f. Anat. u. Physiol.* VI. 1832. s. 371—378. Tab. IV.

*Anaplecta* BURM. Elytra coriaceous, with veins eminent. Posterior wings elongate, reflected at the apex.

Species small, American.

Family XLIII. *Forficulariæ.* Tarsi with three joints. Elytra subcrustaceous, not reticulate, abbreviate, truncated, incumbent on back, placed in contact by a straight suture. Posterior wings membranous, partly folded in longitudinal rays, partly transversely, covered by elytra.

The insects of this family make the transition from the *Orthoptera* to the *Coleoptera*. LINNÆUS counted them with these last, as did also STRAUS amongst more modern writers. LEACH and KIRBY form a distinct order of them, under the name of *Dermaptera* (*Transact. of the Linn. Soc.*, Vol. XI. 1815, p. 87); this name,

which BURMEISTER changed into *Dematoptera*, had been previously (see above, p. 449) given by DE GEER to the order of the *Orthoptera*. LÉON DUFOUR, who subsequently proposed the same separation, named these insects, in imitation of DUMÉRIL, *Labidura;* WESTWOOD *Euplexoptera* (*Zool. Journal*, 1831, *Modern Classification*, I. 1839, p. 308). At all events these insects have greater agreement with the *Orthoptera* than with the *Coleoptera;* they differ from the last by their incomplete metamorphosis and by many particularities of internal structure. The great size of the under-wings in comparison with the elytra is very common in the *Orthoptera* (to refer to *Phasma* alone), and the reflexion of the point of the wing also is not wanting in some other *Orthoptera*, as, *ex. gr. Anaplècta*, the last of the sub-genera of *Blatta* recorded above.

*Forficula* L. Body depressed, narrow, elongate, with prothorax quadrate. Antennæ filiform, a little longer than half the body, with joints very distinct, mostly more than twelve (ten to forty). Ocelli none. Labrum entire, orbicular; mandibles denticulate; labium bifid, with palps short. Abdomen with last segment forcipate, with forceps horny, moveable, in males arcuate, or more open.

Comp. on the anatomy, POSSELT, *Dissert. inaug. sistens tentamina circa Anatomiam Forficulæ auricularicæ* L. *iconib. illustr.* Jenæ, 1800. An extract from it may be found in WIEDEMANN, *Archiv f. Zool. u. Zoot.* 1801, I. 1, s. 230—234, with the corresponding figures, also II. 2. Pl. III. with the explanation by the author himself, s. 230—235.

LÉON DUFOUR, *Recherches Anat. sur les Labidoures, Ann. des Sc. nat.* XIII. 1828. pp. 337—366.

Sp. *Forficula auricularia* L., PANZER, *Deutschl. Ins.* Heft 87, Tab. 8, male; CUV. *R. Ani. éd. ill., Ins.* Pl. 77, fig. 1;—*Forficula minor* L.; PANZER, l. l. Tab. 9, &c.

*Earwigs, perce-oreilles, Ohr-würmer.* It is said that they creep into the ears, and hence this name; this they do not more than other insects, which by chance may get into the ears of persons asleep. They live in moist places, and eat almost everything; they are especially fond of fruits and honey. The females sit on their eggs, and guard them; the young also creep under their mother, like chickens under the hen, and she often sits quietly for hours together over them. DE GEER, *Mém. s. l. Ins.* III. p. 548.

*Note.*—Some are without hind-wings but provided with elytra, or are entirely apterous. According to difference of form and number of joints in antennæ, LEACH, LATREILLE, and especially SERVILLE, have formed several sub-genera, of which it may here suffice to cite the names; *Apachya, Mecomera, Sparatta, Diplatys, Forficula, Echinosoma, Lobophora, Pyragra,*

*Psalidophora* SERV., *Forficesila* LATR., SERV., *Pygidicrana* SERV. Comp. SERVILLE, *Hist. nat. des Orth.* pp. 18—55.

LATREILLE conjoined apterous species under the name of *Chelidura*, spec. of genus *Forficula* SERVILLE.

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Appendix to the Order *Ortheptera.*

*Thrips* L. Body linear, depressed. Head produced inferiorly like a rostrum; labrum elongato-conical; mandibles setiform; maxillæ triangular, acuminate, with short palp, of two joints or three, without galea; labial palps very short, with two or three joints. Antennæ of the length of head and prothorax, filiform, mostly with eight joints (five to nine). Wings mostly four, membranous, narrow, incumbent, with margin ciliated. Feet short, with tarsi biarticulate, the second joint without claw, terminated by a vesicular plantula.

*Note.*—Small insects living in plants, especially in flowers, which were first detected and described by DE GEER in the middle of the last century, under the name of *Physapus.* He then discovered palps; and since the *Hemiptera* are destitute of these, they have been referred improperly to that order by several writers. Some think that they compose an order of their own (*Thysanoptera* HALIDAY, WESTWOOD). They differ from *Orthoptera* by the absence of the *galea.* The family is of uncertain position, intermediate amongst the *Neuroptera, Orthoptera* and *Hemiptera.* Metamorphosis incomplete.

In some the females are provided with a quadrivalve sting or borer, (*Terebrantia* HAL.), in others there is not such a borer, but the abdomen terminates in a tubule (*Tubulifera*). Some species in both sections are apterous.

Comp. DE GEER, *Mém.* III. pp. 1—18. Pl. 1; BURMEISTER, *Handb. der Entom.* II. 2, pp. 404—418; WESTWOOD, *Modern Classification,* II. pp. 1—5, *Generic Synopsis,* pp. 45, 46; LÉON DUFOUR, *Description et figure d'une nouvelle espèce de Thrips* (*Thrips aptera* LÉON DUF., and *Phlœothrips pedicularis* HALIDAY?), *Ann. des Sc. nat.,* sec. Série, Tom. XI. 1839, pp. 321—324, Pl. 8, figs. 8—18; E. HEEGER, *Beiträge zur Naturgeschichte der Physapoden.* Mit Kupfert. *Aus dem Jahrgange* 1852 *der Sitzungsberichte der Kaiserl. Akad. der Wissensch. zu Wien. Besonders abgedruckt.* 8vo.

Sub-genera *Phlœothrips, Heliothrips, Sericothrips, Thrips, Melanthrips, Æolothrips* HALIDAY, *Entom. Magazine,* Tom. III. and IV.

## ORDER XII. *Coleoptera.*

Hexapod insects, with four wings, the anterior hard, coriaceous, covering the posterior membranous, folded back transversely before

the apex. Mouth formed for manducation, furnished with mandibles, maxillæ and palps both maxillary and labial. Metamorphosis complete.

*Shield-winged* (*Coleoptera* from κολεός, *sheath, covering, shield,* and πτερόν, *wing*), with Fabricius *Eleutherata.* We have on this numerous order of insects amongst others the following works :—

J. E. Voet, *Catalogus systematicus Coleopterorum,* Hag. Com. 1769—1806, 4to, II parts. With (1st part 55, 2d part 50) beautifully coloured plates; those of the first part mostly engraved by Kleemann and some by Rœsel, and a very useless Latin, French, and Dutch text. G. W. F. Panzer has supplied a german edition of it with the addition of the synonymy. Erlangen, 1793—1798.

A. G. Olivier, *Entomologie, ou Hist. Natur. des Insectes* (*Coleoptères.*) Paris, 1789—1808, VIII Tomes, 4to, av. (363) pl. enluminées. (The plates make up the last two parts). Sturm has given a less costly edition of the plates, but not complete. Nürnberg. 1802, 1803 (96 plates). Illiger undertook a German edition of the text.

J. C. Fabricii *Systema eleutheratorum.* Kiliæ, 1801, 8vo, II Tomi. *Index Entomologicus* in G. W. F. Panzer, *Faun. Ins. German.* Part I. *Eleutherata.* Norimbergiæ, 1813.

O. J. Schoenherr, *Synonymia Insectorum, oder Versuch einer Synonymie aller bisher bekannten Insecten.* Stoekholm u. Upsala, 1806—1817. 3 *Tle. mit Appendix,* 8vo. *m. illum. Kupfert.* Ejusd. *Synon. Insectorum.* Tom. IV, also under the title of *Genera et Species Curculionidum.* Parisiis, 1833—1845, VIII Tomi.

Déjean, *Spécies général des Coleoptères de la Collection de M. le Comte* Déjean. Paris, 1825—1839, 8vo. 6 Tom. and 7 Vol.

For the anatomy the above-cited Monograph on the Cockchafer by Straus Durckheim may be consulted (see above, p. 256), and also the numerous investigations of Léon Dufour, which extend over the whole of this order. *Ann. des Sc. natur.* Tom. II, III. 1824, IV, V, VI. 1825, VIII. 1826.

This order is distinguished from the preceding by the complete metamorphosis, as also by the absence of a *galea,* howsoever in some two pairs of maxillary palps are present, and morphologically the innermost palps do not differ from the *galea* of the *Orthoptera.*

Simple eyes are not present in the generality of these insects; they occur however in some; two are met with in many small *Brachelytra*, species of *Anthophagus* and *Omalium* (see KLUG, cited above, p. 280), and in *Paussus bucephalus;* and according to CURTIS one is found in the middle of the head in some *Dermestidæ* (WESTWOOD, *Introd. to Mod. Classif.* Vol. I. p. 35). The antennæ have a very different form and length, but consist commonly of eleven joints. The anterior thoracic segment is large and moveable; the middle and last segments of the thorax are entirely covered above by the shield-covers. The under wings are absent in some species, which naturally also in that case are not able to fly, since the shield-covers are not used for flight; these last are never wanting, but are sometimes very short. The integuments of the body are commonly hard, but less so on the dorsal surface, inasmuch as it is covered by the elytra. These insects undergo a perfect metamorphosis. The larva resembles a worm, and commonly has six horny feet[1]. Some larvæ.(*Curculio, Cerambyx*) have no feet, but membranous tubercles in their stead.

Of the diffusion of this order an idea may be formed when we reflect that, according to LATREILLE, more than fifteen years ago about 30,000 species of beetles were known[2], and, according to WESTWOOD, in 1839, 28,000 were found in the British Museum alone. And how many species have there not been since then, and are there not almost daily discovered!

The number of joints in the tarsus was first made use of by GEOFFROY for the division of this order (*Hist. abrégée des Insectes*, I. pp. 50, 51), who was followed by OLIVIER (*Enc. method., Hist. n. d. Ins.* Tom. v. 1791, p. 107), LATREILLE, DUMÉRIL, and nearly all modern writers; a character, of which some have exaggerated the value (see *ex. gr.* ILLIGER in his *Magazin. f. Insektenkunde*, I. 1802, s. 285), but which has some exceptions[3], and moreover cannot always be strictly applied, if we would not violate natural affinity[4]. The normal number of the joints of the tarsus is in this order, as in most hexapod insects, *five*, and therefore by far the most of the

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[1] Comp. DE HAAN, *Mémoires sur les métamorphoses des Coleoptères. Nouvelles Annales du Muséum*, IV. 1835, pp. 125—164, Pl. 10—19.

[2] *Revue Entom. par* SILBERMANN, I. 1833, p. 52.

[3] PH. W. J. MÜLLER, *Bemerkungenüb. die Fussgliederzahl einiger Käfergattungen*, in ILLIGER'S *Magaz. f. Ins.* IV. 1805, s. 197—219.

[4] I communicated some remarks on this subject in OKEN'S *Isis*, 1824. s. 222, 223.

genera belong to the *Pentamera*. The *Heteromera* are such as have an unequal number of joints of the tarsus in different feet, namely, five in the first four feet, four in the last two. The remaining divisions, which have been formed, are *Tetramera*, *Trimera*, *Dimera* and *Monomera;* the last two, however, in consequence of later observations, are obsolete[1], and there remain only the *Trimera* and *Tetramera;* on which we may remark, that, according to more accurate investigation, in the *Trimera* and in many *Tetramera* a small joint has been found situated at the base of the last joint, and which, when this joint is in its ordinary position, is almost concealed and invisible[2]. The *Trimera* are thus in reality *Tetramera;* they are named by WESTWOOD, *Pseudotrimera* (*Cryptotetramera* BURM.). The *Tetramera* of LATREILLE are now named by BURMEISTER *Cryptopentamera*, by WESTWOOD *Pseudotetramera*. The first three or four joints of the tarsus are commonly broad and below flat, furnished with small inequalities and beset with little hairs at the margin. The last joint (the last two joints taken together in the *Pseudotrimera* and *Pseudotetramera*) is small, inversely conical, elongate, horny and smooth, and terminates with curved nails or hooklets.

A. *Pseudotrimera.*

Family XLIV. *Coccinellidæ* (*Aphidiphagi* LATR.) Body nearly semi-globose, above gibbous, below plane. Thorax short, broad, lunate. Antennæ inserted before the eyes, capable of concealment under the head, shorter than thorax, terminated by a capitulum ob-triangular, compressed. Maxillary palps securiform (with last joint large, depressed, triangular); labial palps filiform. Feet short; second joint of tarsus bilobed, broad.

*Coccinella* L.

Sub-genera: *Coccidula* MEGERLE (*Cacicula* STEPH.), *Scymnus* KUGELANN, &c.

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[1] Thus the *Pselaphii* (supposed previously to be *dimera*) have, according to LEACH, three joints, and *Clambus*, the only genus of the so-named *monomera*, has four joints, according to WESTWOOD, *Introd. to mod. Class.* I. p. 37.

[2] PH. W. J. MÜLLER observed this in *Coccinella*, ILLIGER'S *Mag.* s. 218. In *Cerambyx* there are in this way five joints. Comp. also KIRBY and SPENCE, *Introd. to Entomol.* III. pp. 683, 684, and especially W. S. MAC LEAY, *On the Structure of the Tarsus in the tetramerous and trimerous Coleoptera of the French Entomologists, Transact. of the Linn. Soc.* Vol. XV. 1827, pp. 63—74.

Comp. L. REDTENBACHER in GERMAR'S *Zeitschr. f. die Entomol.* v. 1844, pp. 121—132.

Sp. *Coccinella septempunctata* L., RŒSEL, *Ins.* II. *Scar. terrestr.* Cl. III. Tab. H, PANZER, *Deutschl. Ins.* Heft 79, Tab. 3, BRANDT u. RATZEBURG, *Mediz. Zool.* II. Tab. XX. fig. 1. This is throughout Europe the commonest species of these small insects, which in the language of the people is called *Onzen-lieven-Heers-beestjes, Marienkäfer, Vaches à Dieu, Lady-birds.* The six-footed larvæ are elongate, flat beneath, with a small head and twelve rings, which become smaller backwards. They feed on plant-lice. The perfect insects have commonly red or brown shield-covers with black spots, or black shield-covers with red spots. Very many species belong here. Comp. SCHOENHERR, *Synonym.* I. 2, pp. 151—208, and HERRICH-SCHÆFFER, *Synopsis generis Coccinella, Deutschl. Ins.* Heft 128.

*Clypeaster* ANDERSCH. (species of *Cossyphus* GYLLENH.). Body clypeiform. Head concealed in a pit beneath the thorax. Thorax of the breadth of abdomen. Antennæ with nine joints. Tarsi with four joints distinct.

Sp. *Clypeaster pusillus*, AHRENS et GERMAR, *Fauna Insect. Europ.* Fasc. VIII. Tab. 10, GUÉRIN, *Iconogr., Ins.* Pl. 51, fig. 5, &c.

Family XLV. *Fungicolæ* (*Endomychidæ* LEACH). Antennæ longer than head and thorax, clavate or incrassated towards the apex. Maxillary palps filiform, thick. Body oval. Tarsi with second joint bilobed.

*Fungus-inhabitants.* (So named from the abode of most of the species; some live under the bark of trees).

*Endomychus* PAYK. (in part), LATR. Antennæ towards the apex incrassated, filiform. Maxillary palps with last joint ob-triangular. Thorax broader posteriorly, trapezoidal.

Sp. *Endomychus coccineus* PAYK.[1], *Chrysomela coccinea* L., PANZER, *Deutschl. Ins.* Heft 44, Tab. 17, DUMÉRIL, *Cons. g. s. l. Ins.* Pl. 21, fig. 2, CUV. *R. Ani., éd. ill., Ins.* Pl. 74 bis, fig. 3.

*Lycoperdina* LATR. Antennæ filiform, incrassated towards apex. Maxillary palps with last joint ovate. Thorax sub-quadrate.

Sp. *Lycoperdina bovistæ*, *Endomychus bovistæ* PAYK., PANZER, *Deutschl. Ins.* Heft 8, Tab. 4, CUVIER, *R. Ani., éd. ill., Ins.* Pl. 74 bis, fig. 4.

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[1] G. PAYKULL, *Fauna Suecica. Ins.* 8vo. II. 1798, p. 112.

*Eumorphus* WEB. Antennæ clavate, with three terminal joints broad, depressed. Maxillary palps thick, with last joint conical. Thorax trapezoidal, broader posteriorly.

Comp. F. WEBER, *Observat. entomol.* Kiliæ, 1801. 8vo. pp. 31, 59.

Sp. *Eumorphus marginatus* FABR., DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 21, fig. 2 (wrongly named *Eumorphus Sumatræ*), CUV. *R. Ani., éd. ill., Ins.* Pl. 74 bis, fig. 1;—*Eumorph. Sumatræ* WEBER, l. l. p. 59, *Erotylus quadriguttatus* ILLIG., WIEDEMANN'S *Archiv f. Zool. u. Zoot.* I. 2, p. 124, Tab. I. fig. 4, &c.

*Note.*—Add genera *Dapsam* ZIEGL., *Trochoïdeum* WESTWOOD, and some other genera of this family here omitted.

B. *Tetramera* and (*Pseudotetramera.*)

Family XLVI. *Clavipalpi.* First three joints of tarsi spongy beneath, furnished with brushes of setæ, third bilobed. Antennæ filiform, or moniliform, capitate, short. Palps with last joint thick. Body often gibbous, mostly oval, with thorax short, narrow anteriorly, with head small.

These insects (the *club-palps*) are very closely allied to the preceding, wherefore WESTWOOD places them in the division of the *Pseudotrimera* as a third family. They appear to live on Fungi (*Agaricus, Boletus*). The greatest number of species belongs to South America.

† *Maxillary palps malleiform, with last joint transverse, very large, resembling a segment of a circle.*

a) *Internal process of maxillæ bidentate at apex.*

*Erotylus* FABR. (and *Ægithus* ejusd.), LATR.

Comp. P. A. J. DUPONCHEL, *Monographie du genre Erotyle, Mém. du Muséum,* XII. 1825, pp. 30—61, Pl. I. II. pp. 156—176, Pl. III; TH. LACORDAIRE, *Monographie des Erotyliens,* Paris, 1842. 8vo.

Sub-genera; *Omoiotelus* HOPE, *Erotylus* nob. (*Bacis* CHEVROL., HOPE, LACORD., *Priotelus* HOPE, LACORD., *Scaphidomorphus* HOPE, LACORD., *Eurycardius* LACORD., *Zonarius* HOPE, LACORD., *Erotylus* LACORD.), *Ægithus* FABR., LACORD., *Brachysphænus* LACORD., *Coccimorphus* HOPE, LACORD., *Cyclomorphus* HOPE, LACORD., *Euphanistes* LACORD., *Thonius* LACORD. (All from America).

Sp. *Erotylus giganteus* FABR., *Chrysomela gigantea* L., HOUTTUYN, *Natuurl. Hist.* t. IXe Stuk, p. 386, Pl. 74, fig. 3, VOET, *Coleopt.* II. Tab. 33, fig. IV, DUPONCHEL, l. l. Pl. I. fig. 5;—*Erotylus gibbosus* FABR., *Chrysomela gibbosa* L., HOUTTUYN, l. l. fig. 5, VOET, *Coleopt.* II. Tab. 44, fig. II., DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 20, fig. 13, &c.

*Aulacocheilus* CHEVROL., LACORD.

Sp. *Aulacocheilus violaceus*, *Triplax violacea* GERMAR, *Faun. Ins. Europ.* Fasc. XII. Tab. 15. Habit. in Croatia. The remaining species from the Indian Archipelago and Western Africa.

b) *Internal process of maxillæ unidentate at truncated apex.*

*Encaustes* DÉJEAN, LACORD. Body elongate, sub-parallel. Elytra mostly dilated at the base, rather broader than thorax.

Species from East Indies, especially from Java. Comp. LACORDAIRE, *Monogr.* pp. 33—44.

c) *Internal process of maxillæ unarmed, mostly small, ciliated or sub-pubescent.*

*Triplax* PAYK., OLIV., LATR., (*Triplax* and *Tritoma* FABR. not GEOFFR.)

Sp. *Triplax nigripennis* FABR., *Silpha russica* L., DE GEER, *Ins.* V. Pl. 8, figs. 12—15 (*Anthribus ruber*), PANZER, *Deutschl. Ins.* Heft 50, Tab. 7, CUVIER, *R. Ani., éd. ill., Ins.* Pl. 74, fig. 3, &c.

*Dacne* LATR. (in part), LACORD. Tarsi with five joints.

Sp. *Dacne fasciata*, *Engis fasciata* FABR. &c.

†† *Maxillary palps with last joint elongate.*

d) *Tarsi with five joints.*

*Episcapha* DÉJEAN (in part), LACORD.

*Triplatoma* WESTW., LACORD.

*Note.*—Species of genus *Engis* of authors.

b) *Tarsi with four joints.*

*Languria* LATR., OLIV. Body linear, narrow.

*Phalacrus* PAYK. Body oval, gibbous. Antennæ clavate, with club elongate, triarticulate, last joint longer, conical.

Sp. *Phalacrus corticalis*, *Anisotoma corticale* ILLIG., PANZER, *Deutschl. Ins.* Heft 37, Tab. 12, STURM, *Deutschl. Fauna*, *Ins.* II. Tab. XXX. &c.

Family XLVII. *Cyclica.* Joints of tarsi as in the preceding family. Antennæ filiform, or somewhat thicker towards the end only, shorter than body. Maxillæ without horny tooth, with external division palpiform, often biarticulate. Ligula thick, subquadrate or oval, entire or little emarginate.

*Circulars.* They are coleopterous insects of small or only moderate size, which feed on plants, especially on leaves. The species here belonging were collected by LINNÆUS under the genera *Cassida*, *Chrysomela* and *Hispa.*

Phalanx I. *Chrysomela* (*Chrysomelidæ* LEACH). Antennæ remote at the base, inserted before the eyes.

*Chrysomela* L. (exclusive of many species), LATR. (CUV. *R. Ani.*). Head not covered by thorax, exsert.

A. *Antennæ short, moniliform, thicker towards the extremity.*

Sub-genera: *Prasocuris* LATR. (*Helodes* PAYK., FABR.), *Phædon* MEGERLE, *Chrysomela* L. (in part), *Timarcha* MEG. (apterous species), *Paropsis* OLIV., *Doryphora* ILLIG., *Trochalonota* WESTW., *Phyllocharis* DALM., &c.

Comp. HERRICH-SCHÆFFER, *Auseinandersetzung der Gattung Chrysomela, Deutschl. Ins.* Heft 157.

Sp. *Chrysomela Phellandrii* L., *Helodes phellandrii* PAYK., FABR., DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 19, fig. 4, PANZER, *Deutschl. Ins.* Heft 83, Tab. 9; —*Chrysomela populi* L., PANZER, *Deutschl. Ins.* Heft 100, Tab. 5, RATZEBURG, *Forst-Ins.* I. Tab. XX. fig. 4; *Ouvrage posth. de* P. LYONET, Pl. 12, figs. 36—42; this little beetle, 5‴ long, is blue-black, with red-brown or orange-coloured shield-covers, which have a black spot at the point; the larvæ eat the parenchyme of the leaves of poplars, so that the vascular net is left like a skeleton leaf; see RATZEBURG, l. l. Tab. XXI. fig. 6;—*Chrysomela fastuosa* L., PANZER, *Deutschl. Ins.* Heft 44, Tab. 12, &c.

B. *Antennæ filiform, longer than half the body.*

Sub-genera: *Podontia* DALM., *Colaspis* FABR.

*Note.*—DE LA PORTE, *Mém. sur les divisions du genre Colaspis, Revue entomol.* par SILBERMANN, pp. 18—25, proposed several sub-genera.

Does genus *Megamerus* MAC LEAY belong here? Habitus of *Prionus*, thorax oblongo-quadrate. Comp. BOISDUVAL in GUÉRIN, *Magas. de Zool.* 1835, *Ins.* Pl. 124.

*Cryptocephalus* GEOFFR. (in part), FABR. Head vertical, almost entirely intruded within the gibbous thorax.

A. *Antennæ longer than head and thorax.*

Sub-genera: *Eumolpus* FABR., *Eurygpe* DALM., *Choragus* KIRBY, *Cryptocephalus* auctor. &c.

Sp. *Cryptocephalus sericeus* FABR., *Chrysomela sericea* L., PANZER, *Deutschl. Ins.* Heft 102, Tab. 13, CUV. *R. Ani., éd. ill., Ins.* Tab. 72, fig. 4, &c.

The larvæ of *Cryptocephalus* and of the sub-genus *Clythra*, are thick and curved at the posterior extremity like those of the Cockchafer; they live in cases, which they draw along with them, and which, according to GENÉ, are formed of their excrement. *Ann. des Sc. natur.* XX. 1830, p. 143.

SUFFRIAN gave a revision of the European species not long ago, *Linnæa entomolog.* II. 1847. s. 1—194.

B. *Antennæ short, serrate or pectinate.*

Sub-genera: *Lamprosoma* KIRBY, *Chlamys* KNOCH, *Clythra* LAICHARTING, FABR.

Sp. *Clythra quadripunctata, Chrysomela quadripunctata* L., PANZER, *Deutschl. Ins.* Heft 106, Tab. 19, &c.

*Note.*—Almost all the species of sub-genus *Chlamys* are from South America; on which comp. KLUG, *Entomol. Monogr.* 1824, pp. 85—150, and V. KOLLER, *Monogr. Chlamydum.* Cum Tab. æn. color. 2. Viennæ 1824, folio. A new species from the eastern hemisphere (*Chl. indica*) was described by GUÉRIN (*Revue zool.* 1840, p. 41).

Phalanx II. *Galericina* (*Galerucidæ* STEPH.). Antennæ approximate at the base, inserted between the eyes near the mouth (filiform, scarcely or not at all incrassated towards the apex, often longer than half the body).

*Haltica* ILLIG. (*Altica* GEOFFR.). Posterior feet saltatory, with thighs incrassated.

Sp. *Haltica oleracea, Chrysomela oleracea* L., PANZER, *Deutschl. Ins.* Heft 21, Tab. 1, RATZEBURG, *Forst-Ins.* I. Tab. XX. fig. 8; 2‴ long, bluish-green, shining, with a transverse furrow on the hindmost part of the thorax. As larva and perfect insect this little beetle eats all kinds of leaves of trees, garden-plants and pot-herbs, and may cause great damage if it multiplies largely. It is known by the name of *earth-flea*, under which however other species are also included.

Comp. on this genus ILLIGER *Magaz.* VI. and SCHOENHERR *Synon.* I. 2, pp. 300—321.

Sub-genera: *Longitarsus, Dibolia, Psylliodes, Œdionychus* LATR. (CUV. *R. Ani.* 1829, v. pp. 154, 155), and some others proposed by English authors, on which cons. WESTWOOD *Introduct.* II. *Generic Synopsis*, pp. 42, 43.

*Galeruca* GEOFFR., FABR. Posterior feet not saltatory.

Sub-genera: *Luperus* GEOFFR., *Galeruca* GEOFFR., *Phyllobrotica* CHEVR., *Agelastica* CHEVR., *Adorium* FABR., &c.

Sp. *Galeruca alni, Chrysomela alni* L., PANZER, *Deutschl. Ins.* Heft 102, Tab. 3, RATZEBURG, *Forst-Ins.* I. Tab. XX. fig. 6; 3‴ long, violet-blue, shining, elytra with scattered points, feet and antennæ black; this species lives on *Alnus glutinosa*, and is very common;—*Galeruca tanaceti, Chrysomela tanaceti* L., RŒSEL, *Ins.* II. *Scar. terr.* Cl. III. Tab. V. PANZER, l. l. Tab. 2, &c.

*Luperus nasutus* WESTWOOD, GUÉRIN *Magas. de Zool.* 1837, *Ins.* Pl. 177.

Phalanx III. *Cassidina* (*Cassidariæ, Cassidiadæ* LEACH). Antennæ approximate at the base, remote from the mouth, inserted in the upper part of the head (short, exsert, filiform or cylindrical, sub-incrassated towards the extremity).

*Hispa* L. Body ovato-oblong, with head exsert. Antennæ entirely exsert. Thorax trapezoidal or sub-quadrate.

Sub-genus *Alurnus* EABR.

Sp. *Alurnus grossus* FABR., VOET *Coleopt.* II. Tab. 29, fig. 9, DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 19, fig. 3;—*Alurnus marginatus* THUNB., *Hispe bordé* LATR., CUV. *R. Ani.* 1817, Pl. XIII. fig. 5 (2nd edit. 1829, Pl. XIII. fig. 5) &c. Comp. THUNBERG, *Nov. Act. Upsal.* VIII. 1821, pp. 199—202, GUÉRIN, *Note monographique sur le genre Alurnus, Revue Zoolog.* pp. 330—334.

Here also belong sub-genera *Bothrionota, Anisodera, Callistola,* and *Promecotheca* CHEVROL. and DÉJEAN.

*Hispa* L.

(Thorax and elytra frequently aculeate.)

Sp. *Hispa testacea* L., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 19, fig. 3; OLIV. *Entom.* No. 95, Pl. I. fig. 7; habit. in south of France, Italy, and Barbary.

Comp. SCHOENHERR *Synon.* I. 3, pp. 1—7. Add sub-genus *Chalepus* THUNB.

*Cassida* L., LATR. Body clypeiform, plane beneath. Elytra marginate.

*Cassida* L. Head concealed beneath the plane thorax.

Sp. *Cassida viridis* L., RŒSEL, *Ins.* II. *Scarab. terrestr.* Cl. III. Tab. VI., PANZER, *Deutschl. Ins.* Heft 96, Tab. 4; *green shield-beetle,* 3½‴ long,

green, with a black body. The larva lives on thistles, is pale-green, provided with lateral spines, and is covered on the back by its own excrement. The perfect insect, when touched, draws its feet and antennæ under the thorax, and remains so immoveable that it might be supposed to be dead. *Cassida equestris* FABR., PANZER, *Deutschl Ins.* Heft 96, Tab. 5; 4‴ long; differs from the preceding species by the yellow feet, and a yellow margin at the abdomen.—*Cassida nobilis*, L., &c.

Comp. for the species of this genus SCHOENHERR, *Synon.* I. 2, pp. 209—230, which however have been since increased by many new discoveries. F. W. HOPE possesses five hundred of them in his private collection; and knows, at the least, two hundred more. The greatest number (four-fifths) of the known species are found in the new world. See F. W. HOPE, *Observations on the Tortoise or Shield-Beetles, Annals of Natural Hist.* III. 1839, pp. 92—100, Pl. IV., where also some new genera are proposed as divisions of this numerous group.

*Imatidium* FABR. Head received in the thorax, emarginate anteriorly.

Family XLVIII. *Eupoda* s. *Parameca* (*Crioceridæ* LEACH). Tarsi as in the preceding family. Body oblong. Antennæ filiform or somewhat thicker towards the extremity, inserted before the eyes, scarcely longer than head and thorax together. Thorax narrow, cylindrical or quadrate, receiving the head as far as the eyes. Posterior feet in most large, with thickened thighs. Lobes of maxilla membranous, with outer lobe dilated towards the apex, not palpiform.

Phalanx I. *Criocerina*. Mandibles broad, with two or three teeth at the apex. Ligula entire or scarcely emarginate

*Megascelis* DÉJ., LATR. Antennæ almost of the length of body, with joints slender, elongate. Mandibles truncated, thick.

Sp. American: *Lema vittata* FABR., CUV. *R. Ani., éd. ill., Ins.* Pl. 71, fig. 2; *Lema cuprea* FABR.; *Lema nitidula* FABR.; *Megascelis flavipes* DÉJ.; —*Megascelis ænea* STURM, *Catalog. meiner Insectensamml.* 1826, p. 80, Tab. IV. fig. 36, &c.

*Crioceris* GEOFFR., *Lema* FABR. in part. Antennæ scarcely longer than head and thorax. Eyes emarginate.

*Crioceris* LATR. Posterior femora scarcely incrassated or similar to the rest.

Sp. *Crioceris merdigera* FABR., *Ent. Syst.*, *Lema merdigera* FABR. *Syst. Eleuth.*, *Chrysomela merdigera* L., RÉAUM. *Ins.* III. Pl. 17, figs. 1—13, VOET *Coleopt.* II. Tab. 29, fig. 1, PANZER, *Deutschl. Ins.* Heft 45, Tab. 2,

Cuv. *R. Ani., éd. ill., Ins.* Pl. 70, fig. 8; *the red lily-beetle;— Crioceris asparagi, Chrysomela Asparagi* L., Rœsel, *Ins.* II. *Scar. terr.* Cl. III. Tab. IV. Voet, Tab. cit. fig. IV. Panz. *Deutschl. Ins.* Heft 71, Tab. 2; $2\frac{1}{2}$‴ long, with a black-blue abdomen, black head, brown-red thorax, with two black spots, black elytra, each with three yellow spots and a yellow point. The larva and perfect insect live on the asparagus.

*Petauristes* Latr. Posterior femora incrassated.

*Donacia* Fabr. Antennæ scarcely larger than head and thorax. Eyes entire.

*Auchenia* Thunb. Posterior femora not incrassated. Thorax produced at the sides. Last joints of antennæ broader, produced inwardly.

*Donacia* Fabr., Latr. (*Donacia* and *Hæmonia* Meg., Déjean). Posterior femora incrassated. Antennæ filiform, with last joints slender, elongate.

Sp. *Donacia sagittariæ* L., Panz. *Deutschl. Ins.* Heft 29, Tab. 7, Cuv. *R. Ani., éd ill., Ins.* Pl. 70, fig. 5; *Don. Nymphææ* (and *Don. sericea*) Fabr., *Leptura serigea* L. &c. Linnæus enumerated the species known to him under the genus *Leptura*. Comp. on the genus *Donacia*, D. H. Hoppe, *Enumeratio Insectorum elytratorum, circa Erlangam indigenarum*, Erlangæ, 1795, 8vo. pp. 38—48, with 13 col. figs. They are small beetles, living on water-plants, between 3 and 5‴ long, mostly of a shining green, copper-lustrous colour.

Phalanx II. *Sagrida*. Mandibles triangular, with apex acute. Ligula emarginate[1].

*Sagra* Fabr. Eyes reniform, emarginate at the base of antennæ. Posterior femora incrassated, tibiæ incurved. Body narrow, gibbous.

Sp. *Sagra femorata* Fabr., *Tenebrio femoratus* Drury, *Tenebrio viridis* Sulzer *Abgekürtze Gesch. d. Ins.* Tab. VII. fig. 8, Cuv. *R. Ani., éd. ill., Ins.* Pl. 70, fig. 2, Oliv. *Colcopt.* No. 90, Pl. I. fig. 1, &c. Comp. on this genus F. Weber, *Observ. Entomol.* 1801, pp. 60—64. Add *Sagr. Buquettii*, Lesson; *S. Boisduvallii* Dupont, Lesson, *Illustr. de Zool.* Pl. 30, Guérin, *Magasin de Zool.* 1832, *Ins.* Pl. 32, &c.

Sub-genera: *Ametalla, Mecynodera*, Hope; *Megalopus* Fabr. Head nodding; eyes large, protuberant. Body oblong, somewhat broad.

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[1] To this the genus *Pœcilomorpha* of Hope and Lacordaire forms an exception. Perhaps it were better to distinguish both divisions by the mandibles alone, or indeed entirely to drop them.

Comp. MANNERHEIM, *Observations sur le genre Megalopus, Mém. de l'Acad. impér. des Sc. de St Petersbourg,* Tom. x. (1826) p. 293, &c., Pl. 15.

Here belong sub-genera, *Mastostethus* LACORD., *Homalopterus* PERTY, *Agathomerus* LACORD., *Temnaspis* LACORD., and *Pœcilomorpha* HOPE.

*Orsodacne* LATR. Eyes entire. Femora subequal. Maxillary palps with terminal joint elongate, truncated.

Sp. *Orsodacne chlorotica* LATR.; *Crioceris Cerasi* and *Crioc. fulvicollis* FABR.; PANZER, *Deutschl. Ins.* Heft 83, Tab. 8; CUV. *R. Ani., éd. ill., Ins.* Pl. 70, fig. 3.

Family XLIX. *Macrocerata* s. *Longicornia.* Tarsi as in the preceding family. Mandibles broad, triangular, with apex simple, acute. Ligula mostly membranous, cordate, emarginate. Antennæ filiform or setaceous, mostly long, almost of the length of the body or longer than the body. Form of the body elongate, depressed. Eyes in many emarginate, a sinus receiving the base of antennæ.

The *goat-beetles,* or *long-horns.* These insects usually live a long time in the state of larva and then reside in different parts of plants, especially in the inside in the wood, whence some species may become very injurious to the growth of trees. The larvæ have very short feet, or are quite destitute of them, and are vermiform, with rings strongly marked as though by constriction. The goat-beetles have some affinity with the group of the *Lucanidea* amongst the *lamellicornia;* this is however exaggerated, when some writers wish on that account to place this family in the neighbourhood of *Lucanus* L.

Comp. AUDINET SERVILLE, *Nouvelle Classification de la famille des Longicornes, Ann. de la Soc. entomol. de France,* I. 1832, pp. 18—20, II, 1833, pp. 528—573, IV. 1835, pp. 5—100, 197—223.

Phalanx I. *Leptureta* (*Lepturidæ* LEACH, WESTWOOD). Eyes mostly entire, in some sub-emarginate. Antennæ moderate, inserted before the eyes. Head nodding, broader posteriorly than the anterior margin of thorax. Thorax conico-truncated, broader posteriorly. Elytra mostly attenuated towards the apex. Body often arcuate, with feet long.

*Leptura* L. (in part), DÉJ., LATR. Antennæ remote at the base. Thorax mostly not produced into lateral tubercles, with margins smooth.

Sp. *Leptura rubro-testacea* ILLIG. (*Leptura testacea* L. male, and *Lept. rubra* L. fem.) PANZER *Deutschl. Ins.* Heft 69, Tab. 11, 12; RATZEBURG *Forst-Ins.* I. Taf. XVII. figs. 9, 10. Body, head, antennæ, and thighs black, tibiæ and tarsi ruddy, shield-covers of male yellow-brown, of female red-brown, as also the thorax, length of male 7‴, female 8‴. *Leptura armata* PREYSL., SCHOENH., *Strangalia armata* SERVILLE (*Leptura calcarata* FABR. male, *Lept. subspinosa* FABR. fem.), VOET, *Coleopt.* II. Tab. XXVI. fig. 5; *Leptura tomentosa* FABR., OLIV. *Coleopt.* No. 73, Pl. 2, fig. 13, C. DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 18, fig. 2, &c.

(Sub-genus *Heteropalpus* BUQUET. Maxillary palps with a pilose appendage at the base of last joint. GUÉRIN *Magasin de Zool.*)

*Rhagium* FABR. (with addit. of some species of *Leptura* ejusd.), *Stenocorus* GEOFFR., OLIV. Antennæ approximate at the base, inserted on two tubercles between the anterior margin of eyes. Thorax on both sides tuberculated or spinose.

Sp. *Rhagium inquisitor* FABR., *Ceramb. inquisitor* L., PANZER *Deutschl. Ins.* Heft 82, fig. 6;—*Rhag. mordax* FABR., VOET *Coleopt.* II. Tab. 25, fig. 1, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 18, fig. 1, &c.

*Vesperus* DÉJ. Elytra of females short, soft, wings none. Thorax not tuberculate. Insertion of antennæ as in *Rhagium*.

Sp. *Vesperus Solieri* DÉJEAN, GERMAR *Faun. Ins. Europ.* XVIII. Tab. 20; CUV. *R. Ani., éd. ill., Ins.* Pl. 69, fig. 2.

*Desmocerus* DÉJ.

Sp. *Stenocorus cyaneus* FABR., CUV. *R. Ani., éd. ill., Ins.* Tab. cit. fig. 1, GUÉRIN *Iconogr., Ins.* Pl. 46, fig. 1. Hab. in North America.

*Note.*—Several genera and sub-genera of more modern authors, as in this whole family, must be here omitted for the sake of brevity.

Phalanx II. *Cerambicina* (*Cerambycidæ* LEACH). Eyes reniform, surrounding the base of antennæ with an internal sinus. Antennæ long, sometimes longer than body. Head received in thorax as far as the posterior margin of eyes; thorax not narrower anteriorly, nor separated from head by constriction. Labrum exsert, of the breadth of the anterior margin of head. Maxillæ with two distinct lobes.

*Lamia* FABR., LATR. (with the addition of genus *Saperda* FABR. and *Stenocerus* ejusd. in part). Head vertical, inflected. Palps filiform, with last joint oval or subcylindrical, attenuated towards the apex.

a) *With thorax unarmed (not spinose or tuberculate).*

*Saperda* FABR. (with the addition of species of *Stenocorus* ejusd.).

Sp. *Saperda carcharias* FABR., *Cerambyx carcharias* L., PANZER *Deutschl. Ins.* Heft 69, Tab. 1, CUVIER *R. Ani., éd. ill., Ins.* Pl. 68, fig. 9, RATZEBURG *Forst-Ins.* I. Tab. XVI. fig. 4; 1″ to 1″ 2‴ long, antennæ somewhat shorter than body, ash-coloured or yellowish-grey, with many shining, black, raised spots on the thorax and the elytra. The larva lives in different species of poplars;—*Saperda populnea* FABR., *Cerambyx populneus* L., PANZER *Deutschl. Ins.* Heft 69, Tab. 7, RATZEBURG l. l. Fig. 5, small 5‴ to 6‴ long, antennæ of the length of body, brownish with black spots and four yellow spots on each shield-cover; three longitudinal pale-yellow stripes on the thorax; antennæ ringed with white and black; *Saperda oculata, Cerambyx oculatus* L., lives on *Populus tremula*, PANZER *Deutschl. Ins.* Heft 1, Tab. 18, &c.

*Note.*—Sub-genera *Adesmus, Apomecyna, Colobathea*, &c. proposed by DÉJEAN and others are here omitted. Sub-genus *Agapanthia* SERV. is distinguished by antennæ with twelve joints. Sp. *Saperda Cardui* FABR. &c.

b) *With thorax spinose or tuberculate on both sides.*

*Lamia* FABR.

Sp. *Lamia ædilis* FABR., *Cerambyx ædilis* L., *Acanthocinus ædilis* MEGERLE, VOET *Coleopt.* II. Tab. IV. figs. 1—3, RATZEBURG *Forst-Ins.* I. Tab. XVI. fig. 2; antennæ in male four times longer than body, &c.

*Acrocinus* ILLIG., *Macropus* THUNB.

Sp. *Cerambyx longimanus* L., RŒSEL *Ins.* II. *Scar. terr. Præfat.* Cl. II. Tab. I. fig. *a*, VOET *Coleopt.* II. Tab. XII. XIII. fig. 51; *the carpet-beetle, l'Arlequin de Cayenne* (lives in South America); 2½″ long; the antennæ are 5″ and the fore-feet more than 4″ long; the four other feet are much shorter; the thorax has on each side a moveable spine; the shield-covers are truncated at the extremity, and armed with two sharp, horny points.

*Note.*—In some species of this phalanx the eyes are divided into two separate parts by the insertion of the antennæ, the one situated above the other below the base of the antennæ. It is thus in *Saperda præusta* FABR., *Leptura præusta* L. (genus *Tetrops* KIRBY, *Anœtia* DÉJ.) and in some exotic species of *Lamia, e. g. Lamia tornator* FABR., which compose the genus:

*Tetraopes* DALM. and SCHOENH. (See *Synon. Insect.* I. 3, pp. 401, 402.)

*Obrium* MEIG., DÉJ.

*Tmesisternus* LATR.

*Necydalis* L. Head exsert or nutant, not inflected vertically. Palps filiform, truncated at the apex. Elytra less than wings; wings expanded in almost their whole length, replicate at the apex alone. Abdomen elongate, narrow.

*Stenopterus* ILLIG. (Species of *Necydalis* FABR.). Elytra subulate, of length of abdomen.

*Molorchus* FABR. Elytra oval, short, not produced beyond the base of abdomen.

Sp. *Necydalis major* L., *Molorchus abbreviatus* FABR., GRONOV. *Zoophylac.* Tab. XV. fig. 5, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 18, fig. 3, PANZER *Deutschl. Ins.* Heft 41, Tab. 20, &c. Comp. HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 126.

*Note.* — *Stenopterus molorchoïdes*, a species from Chili, described by GUÉRIN, *Magas. de Zool.* 1838, *Ins.* Pl. 233, fig. 2, appears to form the transition between the two genera.

*Cerambyx* L. (exclusive of many species). Head exsert, nutant. Palps truncated at the apex, with last joint ob-triangular. Elytra covering wings and abdomen.

*Callidium* FABR., OLIV. (*Clytus*, *Callidium* FABR. and *Cartallum* MEGERLE, DÉJ.)

Sp. *Cerambyx bajulus* L., PANZER *Deutschl. Ins.* Heft 70, Tab. 1; 10‴ long; the round, flat thorax felty, with two tubercles, broader than head; the body black-brown.

*Cerambyx* FABR. (in part).

(Here belong many sub-genera of more modern authors, *Gnoma* DÉJEAN, *Stenocorus* DALM., DÉJ., *Hammaticherus* MEGERLE, *Callichroma* LATR. (*Aromia* SERV. in part), *Phœnicocerus* LATR., *Ctenodes* OLIV., KLUG, *Lophonocerus* LATR., *Trachyderes* DALM.[1], *Dorcocerus* DÉJ., *Megaderus* DÉJ., *Lissonotus* DALM., &c.)

Sp. *Cerambyx moschatus* L., VOET *Coleopt.* II. Tab. VI. fig. 14, RATZEBURG *Forst-Ins.* I. Tab. XVI. fig. 1, &c.

Phalanx III. *Prionina* (*Prionidæ* LEACH). Eyes emarginate. Antennæ of different length, inserted before the eyes. Labrum small, occupying the middle part of the anterior margin of head

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[1] Comp. on this genus DUPONT, *Monographie des Tracydérides*, GUÉRIN, *Magas. de Zool.* 1836, *Ins.* Pl. 141—146, and 1838, *Ins.* Pl. 186—200.

between the mandibles. Maxillæ with only one lobe or with two, internal very small; mandibles strong, especially in males. Thorax not separated from head by constriction anteriorly.

A. *Antennæ longer than head and thorax together.*

*Prionus* GEOFFR. FABR. Body depressed. Thorax with sides acute, often dentate or spinose. Antennæ in some pectinate or serrate, in others simple, attenuated towards the extremity. Mandibles of males sometimes exsert, long.

Sp. *Prionus coriarius* FABR., *Cerambyx coriarius* L., RŒSEL *Ins.* II, *Scarab. terr.* Cl. II. Tab. I. figs. 1, 2, Tab. II., PANZER *Deutschl. Ins.* Heft 3, Tab. 9; in Germany and other parts of Europe.

To this genus belong some gigantic exotic species, *e.g. Prionus cervicornis, Cerambyx cervicornis* L., RŒSEL *Ins.* II, *Scar. terr.* Cl. II, Tab. I, fig. B; VOET. *Coleopt.* II, Tab. H, figs. 4, 5; CUV. *R. Ani. éd. ill., Ins.* Pl. 64, fig. 3, from South America. *Prionus Hayesii* DOWNES, HOPE *Transac. of the Zool. Soc.* I, Pl. 16, from the west coast of Africa near the Equator.

Some species, with short narrowed elytra, which occur in South America, form the genus *Anacolus* of LATREILLE; other species, also from South America, have besides no wings (*Prionapterus* GUÉRIN).

B. *Antennæ short (of the length of thorax). Head of the same breadth as thorax. Thorax unarmed.*

*Spondylis* FABR. Ligula membranous, cordate. Thorax globose. Body convex.

Sp. *Spondylis buprestoïdes* FABR., *Attelabus buprestoïdes* L., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 17, fig. 6; RATZEBURG *Forst-Ins.* I. Tab. XVII. fig. 12.

*Parandra* LATR. Ligula horny, lunate, transverse. Third joint of tarsus scarcely bifid, last longer than the rest taken together.

Sp. *Sparanda brevis* LATR., *Gen. Crustac. et Ins.* Tab. 9, fig. 7;—*Parandra glabra* GYLLENH., *Attelabus glaber* DE GEER *Ins.* IV. Tab. 19, figs. 14—16, *Scarites testaceus* FABR. The fourth joint of the tarsus is here more apparent than in the other *Pseudotetramera*, so that some count this genus amongst the *Pentamera*.

The *habitus* of these insects resembles that of LUCANUS. LATREILLE first placed this genus in the neighbourhood of *Cucujus* (*Hist. nat. des Crust. et des Ins.* Tom. XI. p. 257) and from later writers also it received the same place; the affinity however with *Spondylis* seems to assign to *Parandra* a place amongst the *Prionidæ*.

Family L. *Scolytaria* (*Scolytidæ* WESTW., *Xylophagi* LATR. in part). Third joint of tarsus in some bilobed, in others entire.

Antennæ shorter than thorax, with first joint elongate, terminal joints forming a club. Head often protracted anteriorly for a while. Palps small, conical.

A small family of small insects, called by the Germans *Borkenkäfer, bark-beetles*, although many do not live in the outer bark (*Borke*), but in the *bast* or *liber* and some in the wood. Some of the species cause great injury to needle-leafed trees (fir, larch, &c.) The larvæ have no feet, any more than those of the following family, with which the *Scolytini*, as already remarked by WESTWOOD, might almost be united. Also the nervous system confirms the affinity. In the abdomen there is no chain of ganglia, but they are all united to form a single ganglion oblongo-conical, which is situated close to the second thoracic ganglia (formed from the union of those of the meso- and metathorax). See the figure of the nervous system of *Scolytus pygmæus* in the memoir of BLANCHARD *Ann. des Sc. nat.* 3ième Série, Tom. v. 1846, *Zool.* Pl. 13, fig. 8. Some affinity with the *Scarabæidea* cannot be mistaken.

Compare ERICHSON *Systematische Auseinandersetzung der Familie der Borkenkäfer* (Bostrichidæ), WIEGMANN'S *Archiv f. Naturgesch.* 1836, s. 45—65.

*Platypus* HERBST, LATR. Head exsert, broad, transverse. Thorax elongato-cylindrical. Body cylindrico-linear. Antennæ sexarticulate, short, with last joint expanded into a club plane, ovate, large. Tarsi with all the joints entire, first long, slender.

Sp. *Platypus cylindricus, Bostrichus cylindrus* FABR., PANZER *Deutschl. Ins.* Heft 15, Tab. 2, RATZEBURG *Forst-Ins.* Tab. x. fig. 13[1].

*Tomicus* LATR., *Bostrichus* FABR. (in part). Head retracted, with thorax produced anteriorly above it. Antennæ inserted in the sides of head between the base of the mandibles and the eyes. Tarsi with all the joints entire.

Sp. *Tomicus typographus, Dermestes typographus* L., PANZER *Deutschl. Ins.* Heft 15, Tab. 3, RATZEBURG *Forst-Ins.* I. Tab. 12, fig. 1; forms in fir-trees beneath the bark labyrinths and passages resembling letters or characters; hence the name of *Typographer*.

[1] Here also seems to be the place of *Tesserocerus* SAUNDERS, where the first antennal joint (in the male) has interiorly a curved process, and the tarsi five joints. A Brasilian insect occasioned the formation of this genus, viz. *Tesserocerus insignis, Damicerus agilis* SPINOLA, GUÉRIN *Magas. de Zool.* 1839, *Ins.* Pl. 3.

Here belong sub-genera *Xyloterus* ERICHSON (*Trypodendron* STEPH.), *Hopotenemus* WESTW., ERICHS., &c.

*Scolytus* GEOFFR. (*Hylesinus* FABR.). Head partly received in thorax, produced into a rostrum short, thick. Tarsi with third joint cordate or bilobed.

Sp. *Scolytus Ulmi* DUMÉR., *Hylesinus Scolytus* FABR., GEOFFROY *Hist. d'Ins.* I. Pl. V. fig. 5; DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 17, fig. 3; RATZEBURG *Forst-Ins.* Tab. X. fig. 4; this species often destroys quantities of elms.

Sub-genera: *Phlœotribus* LATR., *Eccoptogaster* HERBST, *Camptocerus* DÉJ., LATR., *Hylesinus* FABR. (in part), LATR., and *Hylurgus* LATR., and some others proposed by ERICHSON, l. l.

Family LI. *Rhynchophora* (*Curculionides* SCHOENH.). Head anteriorly rostrate, with mouth at the extremity of rostrum. Antennæ inserted in rostrum, very frequently clavate at the extremity. Third joint of tarsi almost always bilobed. Mandibles very frequently small, strong.

*Beaked-beetles.* These are all herbivorous and gnawing insects. Their larvæ have no feet or only tubercles in place of them. A numerous family, of which above 7,000 species are known, which in the last work of SCHOENHERR form more than 630 *genera*[1].

Compare on this family, amongst others:

[CLAIRVILLE] *Entomologie Helvetique*, Vol. I. Zuric, 1798, 8vo. av. fig. col. —C. P. THUNBERG *de Coleopteris rostratis commentatio, Nov. Act. Soc. Upsal.* Vol. 7, 1815, pp. 104—125 in C. J. SCHOENHERR *Curculionidum Dispositio methodica*, Lipsiæ, 1826; and *Syn. insector.*, see above, p. 465.—LATREILLE *Rhyncophores*, in *Dict. class. d'Hist. nat.* Tom. XIV. 1828, pp. 584—603.—The celebrated German entomologist GERMAR, by different communications in the *Magazin* of ILLIGER, and in that edited by himself and ZINCKEN *Magazin der Entomologie* (IV. Bd., 1821, pp. 291—345, *Genera quædam, Circulionitum proposita*) and by descriptions of new species and genera in his *Coleopteror. species nov.* Halæ, 1824, 8vo. pp. 174—461, has conferred great services with respect to this family.

A. *Palps very short, conical. Labrum inconspicuous.*

Phalanx I. *Curculionita* (genus *Curculio* L. in part). Antennæ either arcuate or geniculate, with basilar joint or *scapus* much elongated.

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[1] Thus, about 300 more than LINNÆUS, in the 12th edition of his *Systema naturæ*, adopted for the whole animal kingdom.

† Rostrum elongate. Antennæ geniculate, inserted in the middle or in the base of rostrum.

a) *Antennæ with only ten joints or fewer. Club biarticulate or sub-solid, spongy at the extremity.*

*Dryophthorus* SCHÜPPEL, SCHH. Tarsi with five joints. Antennæ sexarticulate, short. Body elongate.

Sp. *Dr. Lymexylon, Lixus Lymexylon* FABR., PANZER *Deutschl. Ins.* Heft 18, Tab. 11, GUÉRIN *Iconogr., Ins.* Pl. 39 bis, fig. 8; under oak-bark in Sweden and Germany.

*Cossonus* CLAIRV. Antennæ short, with eight joints before the club; club indistinctly articulate or sub-solid. Rostrum deflected. Body elongate, winged.

Sp. *Cossonus ferrugineus* CLAIRV. (and *linearis* ejusd.) *Entom. helv.* I. Tab. I. p. 60, PANZER *Deutschl. Ins.* Heft 18, Tab. 7.

Sub-genera: *Microxylobius* CHEVR., *Rhyncholus* CREUTZER, *Amorphocerus* SCHOENH. and others of this author; *Gen. et Spec. Curculion.* IV. pp. 989—1087.

*Calandra* FABR., OLIV., *Rhynchophorus* HERBST, SCHOENH. Antennæ with seven joints before the club, inserted towards the base of rostrum. Elytra not covering the deflected apex of abdomen. Body winged.

Sub-genera: *Cercidocerus, Trigonotarsus* GUÉRIN, *Macrochirus* DE HAAN and several of SCHOENHERR; comp. l. l. pp. 816—988, VIII. 2, pp. 216—264.

Sp. *Calandra palmarum* FABR., *Curculio palmarum* L., VOET *Coleopt.* II. Tab. 37, fig. 25, CUVIER *R. Ani. édit. ill., Ins.* Pl. 60, fig. 7; South America; —*Calandra ferruginea* FABR., SULZER *Gesch. d. Ins.* Tab. 4, fig. 5, *Curculio hemipterus*, Java, &c.; large exotic species. In Europe, small species alone are met with of this group; everywhere dispersed, *e.g.* is *Calandra granaria*, *Curculio granarius* L., LEEUWENHOECK 57e Missive of 6 Aug. 1687 (*Vervolg der Brieven*, &c. bl. 73—95, with a figure opposite to p. 84); PANZER, *Deutschl. Ins.* Heft 17, Tab. 11; the *common weevil*. This little beaked-beetle may cause great damage in granaries if the corn be not stirred or turned, just like the *wolf*, *Tinea granella*, p. 394.

*Rhina* LATR., OLIV. Antennæ with seven joints or sometimes six before the club, inserted towards the middle of rostrum. Elytra covering the extremity of abdomen. Body winged. Feet, especially anterior, very elongate.

Sp. *Rhina barbirostris, Lixus barbirostris* FABR., *Syst. Eleut.*, VOET *Coleopt.* II. Pl. 35, figs. 2, 3.

*Harpacterus, Sipalus, Sphœrognathus, Strombosurus,* SCHOENHERR, l. l. IV. pp. 802—816.

*Note.*—Here also LATREILLE refers genera *Anchonus* SCHOENH. and *Orthochætes* GERMAR (*Styphlus* SCHOENH.), which are counted amongst the *Erirhinides* by SCHOENHERR, l. l. Tom. III. pp. 507—512.

b) *Antennæ with nine or ten joints, club with three or four joints.*

*Cionus* CLAIRV.

Sp. *Cionus scrophulariæ, Curculio Scrophulariæ* L., VOET *Coleopt.* II. Tab. 38, figs. 30, 32.

*Mecinus* GERMAR, *Nanophyes, Gymnetron* SCHOENH. l. l. Tom. IV. pp. 743—789.

c) *Antennæ with eleven or twelve joints, club with four joints.*

*Cryptorhynchus* ILLIG. Anterior feet distant at the base. Breast channelled for receiving rostrum between the anterior feet.

Here belong many genera of SCHOENHERR which must be omitted for brevity's sake. See his Tom. IV. pp. 1—721.

Sp. *Cryptorhynchus Lapathi, Curculio Lapathi* L., VOET *Coleopt.* II. Tab. 39, fig. 40, PANZER *Deutschl. Ins.* Heft 42, Tab. 15, &c.

*Baridius* SCHOENH. (with addition of other genera). Anterior feet distant, with breast indistinctly sulcate or plane.

Genera: *Baris* GERM., DÉJ., *Leptoschoinus* KLUG and many others proposed by SCHOENHERR; see his Tom. III. pp. 638—821, VIII. pp. 101—293.

*Alcides* DALM.

*Amerhinus* SAHLB., SCHOENH.

*Cholus* GERMAR, SCHOENH.

On this and some other genera, to be inserted here, comp. SCHOENHERR III. pp. 557—636 and VIII. pp. 1—101.

*Orchestes* ILLIG. Anterior feet approximate at the base; posterior feet saltatory, with femora thick.

Small leaping beaked-beetles, of which the larvæ feed on the parenchyme of leaves. Sp. *Orchestes Alni, Curculio Alni* L., VOET *Coleopt.* II. Tab. 40, fig. 51, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 16, fig. 8;—*Orchestes populi, Rhynchænus populi* F., PANZER *Deutschl. Ins.* Heft 18, Tab. 17; *Orchestes fagi, Rhynchænus fagi* GYLLENH., RATZEBURG *Forst-Ins.* I. Tab. IV. fig. 14, &c.

*Tachyerges* SCHOENH.

*Rhynchænus* FABR. (in part), *Erirhinides* SCHOENH. Anterior feet approximate at the base; posterior not saltatory,

*Balaninus* GERMAR. Rostrum slender, arcuate, very long (longer than half the body, sometimes than the whole body).

Sp. *Rhynchænus nucum, Curculio nucum* L., RŒSEL *Ins.* III. *Suppl. Scar. terr.* Cl. IV. Tab. 67, figs. 1—6, PANZER *Deutschl. Ins.* Heft 42, Tab. 21.

*Anthonomus* GERMAR. Rostrum of the length of head and thorax, little arcuate. Feet somewhat long; anterior longer, with thighs thick, dentate. Body sub-oval, pubescent.

Sp. *Rhynchænus pomorum* FABR., *Curculio pomorum* L., VOET *Coleopt.* II. Tab. 35, fig. 8; RATZEBURG *Forst-Ins.* I. Tab. V. fig. 8; V. BERCK *Verhandeling ten bewijze, dat niet de zwarte vliegen, maar de olifants-of snuittorretjes de bedervers zijn van de blœmen der vruchtboomen.* Haarlem, 1827, 8vo. (figure on the title-page.) This little beetle bores in the blossom-buds of the apple a hole with its beak, and lays an egg in it; the larva consumes the anthers and the pistil; the blossoms become brown, and close round the little animal; after four or five weeks the perfect insect makes its appearance from a round aperture in the spoiled blossoms.

Add many genera or sub-genera which must be here omitted; comp. SCHOENHERR Tom. III. pp. 154—489, VII. 2, pp. 27—369.

*Lixus* FABR. Rostrum thickish, little arcuate. Antennæ short, with club oblong, fusiform, four-jointed. Thorax conical, of the breadth of elytra at the base. Body elongate, pubescent, covered with dust (farinose). Elytra sometimes dehiscent at the apex, acuminate.

Sp. *Lixus turbatus* GYLLENH., *Curculio paraplecticus* PANZER *Deutschl. Ins.* Heft 6, Tab. 15, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 16, fig. 10, EVERSMANN *Bullet. de la Soc. Imp. de Moscou* XVI. 1843, pp. 530—534, Pl. VIII. f. 25 (metamorphosis). This species is often confounded with *Lixus paraplecticus* L., *Curculio phellandrii* DE GEER *Ins.* V. Pl. 7, figs. 3—9. The larvæ of this beetle live in the hollow stalk of *Phellandrium aquaticum* and other umbel-flowering plants.

Comp. on this and other allied genera SCHOENHERR III. pp. 1—154, VII. 1, pp. 418—479, 2, pp. 1—26.

†† Rostrum short, thick. Antennæ inserted near the apex of rostrum.

a) *Antennæ with eleven or twelve joints, mostly longer than thorax, geniculate.*

*Curculio* L. (exclusive of many species), FABR., LATR.

*Cleonus* SCHOENH. Rostrum nutant or deflected, longish. Club of antennæ elongate, gradually incrassated. Thorax posteriorly almost of breadth of elytra.

Sp. *Curculio glaucus* (FABR.?) GYLLENH., PANZER in *Naturforscher* XXIV. Pl. 1, fig. 30, VOET *Coleopt.* II. Tab. 40, fig. 52, &c.

*Note.*—On this and many allied sub-genera compare SCHOENHERR l. l. Tom. II. pp. 171—326, VI. 2, pp. 1—295, and on European species of genus *Cleonus* HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 173.

*Molytes* SCHOENH.

Here belong sub-genera *Coniatus, Lepyrus, Plinthus, Tanysphyrus* GERMAR, *Hylobius* SCHOENH., and others, on which compare SCHOENHERR II. pp. 339—408, and VI. 2, pp. 295—389.

*Otiorhynchus* GERMAR. Antennæ long. Wings mostly none.

Here is to be referred sub-genus *Hyphanthus* GERMAR, SCHOENHERR, and several other sub-genera of SCHOENHERR, on which compare II. pp. 551—645, VII. pp. 257—427. Sp. *Curculio ovatus* L., *Curculio pabulinus* PANZER *Deutschl. Ins.* Heft 57, Tab. 19. Compare also, J. WALTON *Notes on the genus Otiorhynchus, Ann. of Nat. Hist.* XIX. 1847, pp. 445, &c.

*Cyclomus* SCHOENH.

Here refer sub-genera *Amycterus* DALM., *Episomus* SCHOENH., and some others proposed by SCHOENHERR, on which compare II. pp. 469—551, VII. 1, pp. 51—256.

*Phyllobius* SCHOENH.

Of this place are sub-genera *Amblyrhinus* SCHOENH., *Macrops* KIRBY, and others, on which see SCHOENHERR II. pp. 424—469, and VII. 1, pp. 1—50. Sp. *Curculio pyri* L., &c., PANZER *Deutschl. Ins.* Heft 107, Tab. 4, &c.

*Byrsops* SCHOENH.

Here is to be referred sub-genus *Lithodus* GERMAR, and some others, on which compare SCHOENHERR II. pp. 408—424, VI. 2, pp. 389—464.

*Brachyderes* SCHOENH.

Here are to be referred almost a hundred sub-genera, nearly all proposed by SCHOENHERR; see I. pp. 515—655, and II. pp. 1—170, V. p. 853, at the end and VI.

*Polydrosus* GERM., SCHOENH.

Sp. *Curculio sericeus* GYLLENH. &c.

*Chlorophanus* DALM.

Sp. *Curculio viridis* L., SULZER *Kennzeichen d. Ins.* Tab. III. fig. 24; SCHÆFFER, *Elem. Entomol.* 1766, Tab. 108, (*Rhinomacer*), PANZER *Deutschl. Ins.* Heft 107, Tab. 3; green, with longitudinal furrows on the shield-covers; beneath, and also along the margins of the shield-covers, yellow; length, $5\frac{1}{2}'''$; very common with us.

*Brachyderes* SCHOENH.

Sp. *Curculio incanus* L., PANZER *Deutschl. Ins.* Heft 19, Tab. 8, RATZEB. *Forst-Ins.* I. Tab. IV. fig. 4, &c. wingless, greyish brown.

*Cneorhinus* SCHOENH.

Sp. *Curculio geminatus* FABR., 3''' long, with very short beak, very round abdomen, wingless, grey brown, with white felt-hairs; very common on our sandbanks.

*Pachyrhynchus* GERMAR.

Here are to be referred several sub-genera, most of them apterous, proposed principally by SCHOENHERR. See his Tom. I. pp. 499—515, V. pp. 800—853.

*Entimus* GERMAR.

Concerning several sub-genera to be referred here, see SCHOENHERR I. pp. 444—499, V. pp. 713—799; apterous, most from Southern Africa (sub-genus *Hipporhinus* SCHOENH., with several species); winged, some from South America, especially Brazil. Sp. *Curculio imperialis* DRURY, FABR., LINDENBERG *Naturforscher* X. p. 86, Tab. II. fig. 1, OLIVIER *Coleopt.* No. 83, Pl. 1, fig. 1, CUVIER *R. Ani. éd. ill., Ins.* Pl. 57, fig. 6.[1]

b) *Antennæ with only nine distinct joints, short, thick, arcuate.*

*Brachycerus* FABR. Body apterous, with elytra connate, gibbous. Feet strong, with tarsi not spongy below.

Sub-genera: *Brachycerus* SCHOENH., *Protomantis* SCHOENH., *Microcerus* GYLLENH., SCHOENH. Comp. SCHOENH. I. pp. 385—444, V. pp. 605—730.

Sp. *Brachycerus apterus* F., *Curculio apterus* L., VOET *Coleopt.* II. Pl. 33, fig. A.—*Brachycerus obesus* FABR., SULZER *Gesch. d. Ins.* Tab. IV. fig. 10,

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[1] This insect is commonly called *Diamond-beetle*, and in gorgeous colour exceeds, perhaps, all other natural objects.

CUVIER *R. Ani. éd. ill., Ins.* Pl. 57, fig. 4; both from the Cape of Good Hope, like most species of this numerous genus; a few occur also in the south of Europe, as *Brachyc. undatus, Brachycère de Barbarie* DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 16, fig. 4.

Phalanx II. *Attelabita* (*Attelabidea* WESTW., genus *Attelabus* L. in part). Antennæ straight.

*Attelabus* L., FABR. (in part), *Rhinomacer* GEOFFR., CLAIRV. (not FABR.). Antennæ eleven- or twelve-jointed, with three or four last thicker, forming a club. Body oval, narrowed anteriorly. Third joint of tarsus bilobed.

Sub-genera: *Apion* HERBST, *Rhynchites* HERBST, *Attelabus* LATR., *Apoderus* OLIV., and others, on which comp. SCHOENHERR I. pp. 187—240, v. pp. 247—309.

On genus *Apion* compare KIRBY'S Monograph in *Linn. Transact.* Tom. X. and XI.

Sp. *Attelabus coryli* (and *Attel. avellanæ*) L., SULZER *Kennz. der Ins.* Tab. VI. f. 25, PANZER *Deutschl. Ins.* Heft 100, Tab. 8, RATZEB. *Forst-Ins.* I. Tab. IV. fig. 5; this little beetle rolls up the leaves of hazels and other trees to form a well-closed case, in which the larva lives. (See fig. in RATZEBURG, bl. 97.)

*Attelabus frumentarius* FABR., *Curculio frumentarius* L., CLAIRV. *Ent. helv.* I. Tab. 13, f. 1, 2, PANZER *Deutschl. Ins.* Heft 20, Tab. 14, &c.

*Ramphus* CLAIRV. Posterior feet with incrassated femora, saltatory.

Sp. *Ramphus flavicornis* CLAIRV., *Entom. helv.* I. Tab. 12 (LATREILLE places this genus in the preceding division next *Orchestes*).

*Rhinotia* KIRBY.

*Auletes* SCHOENH.

On these and some other genera, omitted here for the sake of brevity, comp. SCHOENHERR I. p. 243, and foll. V. p. 345, and foll.

*Camarotus* GERM.

See SCHOENHERR I. pp. 185—187.

*Cylas* LATR. Antennæ with ten joints, last very long, thicker, rest very short, transverse. Thorax constricted in the middle.

Compare SCHOENHERR I. pp. 369—373.

*Ulocerus* SCHOENH.

*Brentus* FABR., LATR. (*Brenthus* ILLIG.). Antennæ filiform, not clavate, eleven-jointed. Last joint of tarsi bilobed. Rostrum exsert, often very long. Body linear, elongate.

Sp. *Brentus anchorago, Curculio anchorago* L., VOET *Coleopt.* II. Pl. 34, figs. I. II., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 16, fig. 11, South America; —*Brentus* (*Eutrachelus*) *Temmincki* LATR., from Java; fig. in *Dictionn. univ. d'Hist. nat., Col.* Pl. 9, fig. 1.

*Note.*—See other sub-genera described in SCHOENH. I. pp. 313—369, V. pp. 465—580.

B. *Palps filiform or thicker towards the apex. Labrum distinct.*

Phalanx III. *Bruchidea* (*Bruchidæ* LEACH).

*Anthribus* FABR. (and *Rhinomacer* ejusd. in part). Antennæ clavate. Eyes in most entire. Third joint of tarsi small, often sub-included in second.

Sub-genera: *Platyrhinus* CLAIRV., *Tropideres* SCHOENH., *Brachytarsus* SCHOENH. and several others; comp. SCHOENHERR I. pp. 115—185, V. pp. 147—277.

Sp. *Anthribus scabrosus* F., PANZER *Deutschl. Ins.* Heft 15, Tab. 15, &c.

*Mecocerus* SCHOENH. Antennæ in females passing gradually into a club oblong, acuminate at the extremity, of the length of head and thorax, in males longer than twice the body, attenuated at the apex. Thorax in males armed beneath with a pair of spines.

Sp. *Mecocerus gazella* SCHOENH., *Acanthothorax longicornis* GÆDE, in GUÉRIN *Magas. de Zool.* 1832. *Ins.* Pl. 15, habitat Java. Male resembles *Lamia ædilis*, in the length of antennæ.

*Bruchus* L. Antennæ filiform, gradually thicker, with short joints, often serrate, sometimes sub-pectinate. Eyes emarginate. Third joint of tarsi distinct, bilobed. Elytra not covering the extremity of abdomen.

Sub-genera: *Urodon* SCHOENH., *Spermophagus* STEVEN, *Carpophagus* MAC LEAY. Comp. SCHOENH. I. pp. 31—114, V. pp. 1—147.

*Bruchus pisi* L., SCHOENH.; *Bruchus rufimanus* SCHOENH., PANZER *Deutschl. Ins.* Heft 66, Tab. 14, &c.

Compare HERRICH-SCHÆFFER *Auseinandersetzung der Gattung Bruchus, Deutschl. Ins.* Heft 172.

C. *Heteromera.* Tarsi of four anterior feet five-jointed, of posterior feet with four joints.

† *Atrachelia.*

Head sub-oval, posteriorly retractile into the thorax, towards the base not abruptly narrowed, or without neck.

Family LII. *Stenelytra.* Body with very few exceptions winged. Maxillæ with internal process mostly unarmed. Mandibles terminated by apex simple in some, in others bifid. Antennæ filiform, in many longer than thorax and head together, in few only sub-perfoliate. Penultimate joint of tarsi often bilobed.

*Narrow-shielded.* This denomination is not appropriate for all the species, and this family of LATREILLE, in fact, is neither very natural nor sharply defined; we retain it only because unwilling to multiply too largely the number of families in our concise revision. The larvæ have six feet, but differ in other respects in the different genera of this division. They live under the bark of trees or in decaying wood.

Phalanx I. *Rhynchostomata* LATR., *Salpingidæ* LEACH, WESTWOOD. Head rostrate anteriorly.

*Rhinosimus* LATR. (*Salpingus* ILLIG., *Anthribus* CLAIRV., species of *Anthribus* FABR.). Antennæ moniliform, with three or five terminal joints thicker, forming an elongate club. Thorax posteriorly constricted, narrower than the base of elytra.

Sp. *Rhinosimus planirostris, Anthribus planirostris* FABR., PANZER *Deutschl. Ins.* Heft 15, Tab. 14.

*Mycterus* CLAIRV. Antennæ filiform not clavate, with twelve short joints. Thorax anteriorly narrower, posteriorly broader.

Sp. *Mycterus curculioïdes, Rhinomacer curculioïdes* FABR., PANZER *Deutschl. Ins.* Heft 12, Tab. 8, CLAIRVILLE *Entom. helv.* I. Tab. XVI. p. 124, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 16, fig. 2, &c.

Comp. on this genus OLIVIER *Encycl. méth., Ins.* Tom. VIII. pp. 79, 80.

*Stenostoma* LATR. Antennæ filiform, with joints elongate. Body elongate. Thorax broader posteriorly.

Sp. *Stenostoma rostratum* CHARPENT., *Leptura rostrata* FABR., GUÉRIN *Icon., Ins.* Pl. 33, fig. 8, &c.

Phalanx II. *Œdemerites* LATR. Head not produced into a rostrum. Mandibles bifid. Posterior femora in males of many species incrassated.

*Œdemera* OLIV., LATR. Antennæ inserted between the eyes, filiform or setaceous, sometimes serrate, mostly elongate, eleven-jointed (of *males* sometimes twelve-jointed). Eyes globose or reni-

form. Last joint of maxillary palps often large, triangular. Penultimate joint of tarsi bifid. Body mostly narrow, elongate. Elytra often soft and flexible, in many posteriorly acuminate.

A) *Antennæ short, nearly equalling half the body. Claws of tarsi bifid.*

Sub-genus *Nothus* ZIEGLER, OLIV.

Comp. OLIVIER *Encyclop. méth., Hist. nat. Ins.* Tom. VIII. pp. 383, 385.

B) *Antennæ elongate (almost of the length of body). Claws of tarsi entire.*

Sub-genera: *Calopus* FABR., *Sparedrus* MEGERLE, *Dytilus* FISCH., *Nacerdes* STEVEN, *Œdemera* OLIV. (Species of *Necydalis* L., FABR., *Dryops* FABR.)

Sp. *Œdemera sanguinicollis, Necydalis sanguinicollis* FABR., PANZER *Deutschl. Ins.* Heft 24, Tab. 18, named *Necyd. flavicollis*;—*Œdem. notata, Necydalis notata* FABR., *Nacerdes notata* STEV., DÉJ., &c.

*Calopus serraticornis* FABR.; *Cerambyx serraticornis* L.; DUMÉR. *Cons. gén. s. l. Ins.* Pl. 12, fig. 4; GUÉRIN *Iconogr., Ins.* Pl. 33, fig. 5, PANZER *Deutschl. Ins.* Heft 3, Tab. 15; habitat north of Europe.

Comp. OLIVIER *Encycl. méth.* l. l. pp. 437—450, and W. SCHMIDT *Revision der europäischen Œdemeriden; Linnæa entomologica* 1. 1846, pp. 1—146, where also some new genera are proposed.

Phalanx III. *Serropalpides* LATR. (*Melandryadæ* LEACH). Head not produced into a rostrum. Mandibles emarginate or bifid at the extremity. Posterior femora not incrassated. Claws of tarsi simple. Penultimate joint of tarsi mostly bilobed. Maxillary palps often serrate, with last joint large, securiform.

*Serropalpus* HELLENIUS, PAYK.

*Melandrya* FABR.

Sp. *Melandrya serrata* FABR., *Chrysomela caraboïdes* L., PANZER *Deutschl. Ins.* Heft 9, Tab. 3, CUV. *R. Ani. éd. ill., Ins.* Pl. 53, fig. 1, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 12, fig. 2?

*Dircæa* FABR.

Add genera *Conopalpus* GYLL., *Hypulus* PAYK., *Hallomenus* PAYK., and some others.

Phalanx IV. *Cistelides* LATR. (*Cistelidæ* KIRBY, WESTW., *Xystropides* SOLIER). Head scarcely or not at all produced into a

rostrum. Antennæ at the base not obtect by the margin of head. Claws of tarsi denticulate. Penultimate joint of tarsi mostly entire, in few bilobed.

The larvæ live for the most part in hollow trunks of trees. The perfect insects are mostly seen on flowers and hedges. Many of them have soft, thin elytra.

Comp. on this group of beetles SOLIER *Prodrome de la Famille des Xystropides, Ann. de la Soc. Entom.* IV. 1835, pp. 229—248.

a) *Maxillary palps with last joint large, securiform.* (*Mandibles often bifid or tridentate at the apex.*)

*Mycetochares* LATR. (*Mycetophila* GYLLENH., DÉJEAN, species of *Cistela* FABR.).

Sp. *Mycetochares barbata, Melandrya barbata* FABR., STURM *Deutschl. Fauna, Ins.* II. Tab. 52, PANZER *Deutschl. Ins.* Heft 105, Tab. 5.

*Allecula* FABR.

b) *Maxillary palps filiform, incrassated towards the apex.* (*Mandibles entire.*)

*Cistela* FABR. (in part), *Cteniopus* SOLIER (and *Megischia* ejusd.). Penultimate joint of tarsi entire. Head protracted before the eyes.

Sp. *Cistela sulphurea* FABR., *Chrysomela Sulphurea* L., PANZER *Deutschl. Ins.* Heft 106, Tab. 8, CUV. *R. Ani. éd. ill., Ins.* Pl. 52, fig. 5; 4‴ long; the whole body, the elytra and feet sulphur-yellow; black eyes; in the middle of summer common on umbellate and other flowers.

Phalanx V. *Helopii* LATR. (*Helopidæ* STEPHENS, WESTWOOD). Head not produced into a rostrum. Antennæ inserted before the eyes under the exsert margin of head, covered at the base. Claws of tarsi entire. Palps with last joint large, truncated. Penultimate joint of tarsi mostly entire or not deeply bilobed.

a) *Prosternum not produced posteriorly to form a pointed projection.*

* *Body elongate, narrow.*

*Strongylium* KIRBY (with addition of genus *Stenochia* ejusd.)

*Stenotrachelus* LATR.

** *Body oval, oblong.*

*Læna* MEGERLE, DÉJ. Thorax obcordato-truncate. Antennæ filiform, incrassated towards the apex.

Sp. *Læna pimelia, Helops pimelia* FABR., CUV. *R. Ani. éd. ill., Ins.* Pl. 51, fig. 10.

*Helops* FABR. (in part). Thorax sub-quadrate, wings small, imperfect.

Sp. *Helops caraboïdes* PANZER, *Deutschl. Ins.* Heft 24, Tab. 3, STURM *Deutschl. Fauna, Ins.* II. Tab. 50, &c.

*** *Body oval, arched above.*

*Spheniscus* KIRBY. Antennæ thicker towards the extremity, with five last joints broader, forming a depressed club. Thorax trapeziform. Body winged.

Sp. *Spheniscus erotyloïdes* KIRBY, *Trans. of the Linn. Soc.* XII. 22, 4, *Centurie d'Insectes* (Fr. edit. Paris, 1834, 8vo.) p. 47, Pl. 3, fig. 4; from South America, like the remaining species.

*Adelium* KIRBY. Antennæ filiform. Thorax short, broad. Body apterous.

Sp. *Adelium calosomoïdes* KIRBY, ibid. XXII. 2, *Centurie* p. 45, Pl. 3, fig. 3, from N. Holland.

*Note.*—Add genus *Sphærotus* KIRBY, *Acanthopus* MEGERLE, DÉJ., and some others, on which consult LATREILLE, CUVIER *R. Ani. éd.* 2, IV. p. 38.

b) *Prosternum produced posteriorly to a point, to be received in a cavity of mesosternum.*

*Cnodalon* LATR.

*Epitragus* LATR.

Compare LATR. *Gen. Crust. et Insect.* II. pp. 182, 183. Add genera *Campsia* and *Camaria,* LEPELETIER et SERVILLE, *Enc. méth., Hist. nat. Ins.* Tome X. pp. 454—456.

Family LIII. *Taxicornes* LATR. (*Diaperidæ* LEACH, WESTWOOD). Body winged. Maxillæ on the inside mostly not unguiculate. Antennæ not longer than head and thorax together, towards the apex incrassated or terminated by a club, moniliform or perfoliate, mostly inserted under the exsert margin of head. Tarsi with joints entire, terminated by claws simple.

Phalanx I. *Cossyphides* WESTWOOD. Head immersed in thorax or obtect. Maxillary palps with last joint broad, securiform. Elytra marginate.

*Nilio* LATR. Head small, received in thorax. Thorax broad, very short. Body semiglobose. Antennæ incrassated towards the extremity.

Sp. *Nilio villosus* LATR., *Ægithus marginatus* FABR., LATR., *Gener. Crust. et Ins.* Tab. X. fig. 2; CUV. *R. Ani. éd. ill., Ins.* Pl. 5, fig. 10; South America. This insect in its form resembles *Coccinella.*

*Heleus* LATR., KIRBY. Head margined by thorax produced forwards. Body plane. Antennæ incrassated towards the extremity.

*Helæus perforatus* LATR., CUV. *R. Ani. éd.* I. Tab. XII. fig. 6, *éd.* II. Tab. XVII. fig. 6; New Holland.

*Cossyphus* OLIV., FABR. Head covered by clypeiform thorax. Antenna terminated by a club perfoliate.

Sp. *Cossyphus depressus* FABR. (excl. Synon.), *Cossyph. Hoffmanseggii* HERBST, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 15, fig. 8, CUV. *R. Ani. éd. ill., Ins.* Pl. 50, fig. 8; in Portugal and in North Africa, &c. Comp. SCHOENHERR *Synon. Ins.* I. 3, pp. 58, 59;—*Coss. tauricus* FISCH., *Bullet. de la Soc. Imp. de Moscou*, 1832, Tom. IV. Tab. V. *f.* 1, 2.

Phalanx II. *Diaperiales.* Head not received in thorax or obtect. (Maxillary palps mostly filiform. Body immarginate.)

*Eledona* LATR. (*Bolitophagus* FABR.)

*Coxelus* ZIEGL., DÉJ.

*Lithophilus* FROELICH.

Sp. *Lithophilus ruficollis* J. A. FROELICH *Neue Gattungen und Arten von Käfer, Naturforscher* 28 St., 1799, Tab. I. fig. 12; LATREILLE placed this genus with *Coccinella.*

*Trachyscelis* LATR.

*Hypophlæus* FABR.

Sp. *Hypophlæus castaneus* FABR., PANZER *Deutschl. Ins.* Heft 12, Tab. 13, DUMÉR. *Cons. gén. s. l. Ins.* Pl. 15, fig. 2.

*Note.*—Here ought, as it seems, to be inserted genus *Nycteropus* KLUG (with genus *Dolichoderus* ejusd.) ascribed by GUÉRIN to the *Helopii.*

GUÉRIN *Magasin de Zool.* 1839, *Ins.* Pl. 203.

*Diaperis* GEOFFR. Maxillary palps filiform. Internal process of maxilla unarmed. Antennæ with fourth joint and following transverse, dilated.

Sp. *Diaperis boleti, Chrysomela boleti* L., GEOFFR. *Hist. d'Ins.* I. Pl. VI. fig. 3, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 15, fig. 5; 3‴ long, 2‴ broad, black, the elytra with two orange transverse bands, and an orange spot at the point.

Sub-genus: *Neomida* ZIEGL., *Oplocephala* LAPORTE and BRULLÉ.

Compare DE LA PORTE et BRULLÉ, *Monographie du genre Diaperis, Ann. des Sc. nat.* Tom. XXIII. 1831, pp. 325—410, Pl. 10.

Add sub-genera, in which the last joint of maxillary palps is broad, truncated *Platydema* LAP. and BR., *Ceropria* and some others l. l.

*Phaleria* LATR. (*Uloma, Phaleria* DÉJ.). Internal process of maxilla armed with a horny claw. Maxillary palps with last joint incrassate, obtrigonal, truncated.

Sp. *Phaleria cadaverina, Tenebrio cadaverinus* FABR., STURM *Deutschl. Fauna, Ins.* II. Tab. 47, fig. *a*, A, B, CUV. *R. Ani. éd. ill., Ins.* Pl. 50, fig. 1, &c.

Family LIV. *Melasomata* LATR. Body often apterous. Antennæ scarcely longer than head and thorax conjointly, inserted under the exsert margin of head, mostly short, moniliform, with second joint short, third in most elongate. Internal lobe of maxilla almost always armed with a horny tooth or claw. Mandibles bifid or emarginate at the apex.

Most of these beetles have a black colour; others are brown or grey, without contrasting spots; they are shy of the light and live almost all on the ground, where they conceal themselves in corners or under stones. The shield-covers of the wingless species are grown together, and at the sides bent downwards.

Compare on this family GUÉRIN, *Matériaux pour une classification des Melasomes, Magas. de Zool.* 1834, *Ins.* Pl. 101—118.

Phalanx I. *Tenebrionita* (*Tenebrionidæ* LEACH, WESTWOOD). Body winged; elytra loose. Maxillary palps with last joint broad, truncated.

A) *Body elongate. Thorax sub-quadrate. Antennæ moniliform, gradually thicker towards the apex.*

*Heterotarsus* LATR. Antepenultimate joint of tarsi deeply bilobed, receiving the penultimate very small.

Sp. *Heterotarsus tenebrioïdes* LATR., CUV. *R. Ani. éd. ill., Ins.* Pl. 49, fig. 11, from Senegal.

*Tenebrio* L. (in part). Penultimate joint of tarsi distinct, not concealed in preceding.

*Tenebrio* FABR., *Upis* FABR., *Calcar* DÉJ. (species of *Trogosita* FABR.)

Sp. *Tenebrio molitor* L., PANZER *Deutschl. Ins.* Heft 43, Tab. 12, STURM *Deutschl. Fauna, Ins.* II. Tab. 46, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 13, fig. 2; the *meal-beetle;* above 7‴ long, black, brown beneath, elytra striated. The larva (*meal-worm*), well-known in corn-mills, granaries, and bread-bakers' establishments, is elongate, cylindrical, white, and has twelve rings besides the head.

B) *Body elongate. Thorax sub-quadrate, elongate. Antennæ clavate or thick at the apex, fusiform.*

*Toxicum* LATR. Antennæ with four terminal joints forming a club, last sub-orbicular, rest transverse. Tibiæ simple.

Add genus *Boros* HERBST.

*Chiroscelis* LAM., LATR. Antennæ with last joint globose, thick. Tibiæ of anterior feet dilated, digitate. Thorax elongate, posteriorly constricted, narrower than the base of elytra.

Sp. *Chiroscelis bifenestratus*, LAMARCK *Annal. du Muséum* III. 1804, p. 262, 263, Pl. 22, fig. 2; GUÉRIN *Iconogr., Ins.* Pl. 30, fig. 5.

*Sarrotrium* ILLIG., FABR. (*Orthocerus* LATR.). Antennæ fusiform, thick, pilose.

Sp. *Sarrotrium muticum, Hispa mutica* L., PANZER *Deutschl. Ins.* Heft 1, Tab. 8, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 13, fig. 5; found in sand-pits.

*Corticus* DÉJ. Sp. *Sarrotrium celtis* GERM.

C) *Body oval. Thorax transverse, trapezoïdal, anteriorly narrower, posteriorly of the breadth of elytra.*

*Opatrum* FABR. (exclusive of many species). Clypeus emarginate, including labrum. Antennæ shorter than thorax. Thorax of the breath of elytra, marginate.

Sp. *Opatrum sabulosum* FABR., *Silpha sabulosa* L., PANZER *Deutschl. Ins.* Heft 3, Tab. 2, STURM *Deutschl. Fauna, Ins.* II. Tab. 40, CUV. *R. Ani. éd. ill., Ins.* Pl. 49, fig. 2[1];—*Opalium tibiale* FABR. (*Microzoon* DÉJ.), PANZER *Deutschl. Ins.* Heft 43, Tab. 10.

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[1] Of this species, as also of *Sarrotrium muticum*, SCHIODTE has communicated an anatomical description in KRÖYER'S *Natuurk. Tidskr.* IV. 1843, pp. 204—211.

*Crypticus* LATR. Body oval, convex, smooth. Clypeus not emarginate. Antennæ of the length of thorax. Tarsi with first joint elongate.

Sp. *Crypticus glaber* LATR., *Blaps glabra* FABR.; CUV. *R. Ani. éd. ill.* Pl. 49, fig. 1; the larva, which is met with in decayed willow-wood, is filiform, cylindrical, and resembles that of *Helops* BOUCHÉ, *Naturgesch. d. Ins.* s. 191.

Phalanx II. *Blapsida* (*Blapsidæ* STEPHENS, WESTWOOD). Body apterous, with elytra united together. Maxillary palps with last joint larger, securiform or obtrigonal. (Genus *Blaps* FABR.)

A. *Body oval, short. Thorax transverse, posteriorly broader, trapezoïdal. Elytra with sides little or not at all inflected under abdomen. Tarsi of anterior feet in males dilated, often hirsute beneath.*

*Pedinus* LATR.

† *With clypeus entire:* Sub-genus *Platyscelis* LATREILLE.

†† *With clypeus emarginate:* Sub-genera *Pedinus* DÉJ., *Isocerus* MEGERLE, *Pedonocus* WATERHOUSE, *Eurynotus* KIRBY, *Heliophilus* DÉJ., *Dendarus* MEGERLE, DÉJ. Compare LATREILLE in CUV. *R. Ani. scc. éd.* v. pp. 19, 20, WATERHOUSE *Ann. and Mag. of Nat. Hist.* XVI. pp. 32—36.

*Note.*—Coleoptera allied to genus *Opatrum*, but apterous.

B. *Body oblong. Elytra at the sides inflected downwards, posteriorly often produced into an inflected pointed process.*

*Blaps* FABR. (in part).

Sub-genera: *Asida* LATR., *Scotinus* KIRBY, *Machla* HERBST, *Heteroscelis* LATR.

*Gonopus* LATR.

*Blaps* (*Blaps* and *Dila* FISCH.), *Prosodes* ESCHSCH.

Comp. FISCHER *Bullet. de la Soc. des natural. de Moscou*, Tom. XVII. 1844, pp. 111—118, Tab. II, Sp. *Blaps lævicollis* GEBL.

*Misolampus* LATR., *Heliofugus* GUÉRIN, *Acanthomera* LATR., *Oxura* KIRBY.

Sp. *Blaps mortisaga* FABR., *Tenebrio mortisagus* L., HOUTTUYN *Nat. Hist.* I. 10, Tab. 78, fig. 3, PANZER *Deutschl. Ins.* Heft 3, Tab. 3; 10‴ or 11‴ long, dull black; lives in cellars and other dark places. Some anatomical notices on this species and on *Blaps gages* FABR. (PANZER *Deutschl. Ins.* Heft 96, Tab. 1, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 14, fig. 1) were given by J. F. MECKEL *Beiträge z. vergl. Anat.* I. 2. s. 123—126.

Phalanx III. *Pimelaria.* Body apterous, with elytra united together. Maxillary palps filiform, with last joint scarcely larger than the rest, subcylindrical.

A. *Mentum subquadrate, entire, narrower at the base.*

*Moluris* LATR.

Sp. *Pimelia striata* FABR., VOET *Coleopt.* II. Tab. 50, fig. 1.

*Trachynotus* LATR.

*Sepidium* FABR.

*Scaurus* FABR.

*Tagenia* LATR.

*Note.*—Several sub-genera of modern writers to be added, which are here omitted for the sake of brevity. These are counted amongst the *Blapsidæ* by the celebrated entomologist WESTWOOD.

B. *Mentum very broad, mostly not narrowed at the base, covering maxillæ beneath, anteriorly emarginate or bilobed, cordate.*

† *Mentum anteriorly concave, cordate. Antennæ with only ten distinct joints.*

*Adelostoma* DUP.

*Eurychora* THUNB., FABR.

Sp. *Eurychora ciliata* THUNB., VOET *Coleopt.* II. Tab. 43, fig. 23, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 14, fig. 3;—*Eurych. cimicoïdes* QUENSEL, SCHOENH. *Syn. Ins.* I. p. 137, Tab. II. fig. 5, &c.

*Steira* WESTW.

Sp. *Steira costata* WESTWOOD in GUÉRIN *Magas. de Zool.* 1837, *Ins.* Pl. 176.

†† *Mentum bilobed, rotundate. Antennæ with eleven joints.*

*Akis* HERBST, FABR. (exclusive of some species).

*Tentyria* LATR.

*Hegeter* LATR.

*Erodius* FABR.

Sub-genera: *Nyctelia, Zophosis, Erodius* LATR.

*Note.*—WATERHOUSE has described several new species of *Nyctelia*, *Proceedings of Zool. Soc.* IX. 1841, pp. 105—121.

*Pimelia* FABR. (in part).

Sub-genera: *Cryptochilus, Trachyderma* LATR., and some others here omitted.

Sp. *Pimelia bipunctata* FABR., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 14, fig. 2, CUV. *R. Ani. éd. ill., Ins.* Pl. 46, fig. 1, &c.; *Tenebrio muricatus* L., a congeneric species, is often confounded with the preceding. See SCHOENHERR *Synon. Ins.* I. p. 132.

*Note.*—There is an affinity between this family and the *carabici:* some genera agree in *habitus;* thus genus *Damaster* KOLLAR amongst the *Carabici* almost presents the form of the *Blaptides,* but *Manticora* resembles *Pimelia coronata.* The anatomy also proves this affinity, as BLANCHARD has lately shewn by the investigation of the nervous system. *Ann. des Sc. Nat.* 3ième Série V. *Zoologie,* p. 350. The larvæ, however, are altogether different.

†† *Trachelia.*

Head cordate, abruptly narrowed posteriorly and separated from thorax by a stricture or neck.

Family LV. *Cantharidia* (*Trachelides* LATR., *Cantharidii,* except *Cistelides,* BLANCH.).

Phalanx I. *Meloëida* (*Cantharidiæ* LATR.). Antennæ moniliform. Head nutant. Maxillary palps filiform, with last joint scarcely thicker, oval or obovate; labial palps with last joint broader, truncated. Elytra soft. Joints of tarsi mostly entire. Claws of tarsi bifid. (Genus *Meloë* L.)

† *Wings none; elytra (at least in females, mostly also in males) abbreviate.*

*Meloë* FABR. Antennæ with eleven joints, filiform, sometimes thicker in the middle, in few subincrassated at the apex.

Sp. *Meloë proscarabæus* L., GEOFFROY *Hist. des Ins, des env. de Paris,* I. Tab. VII. fig. IV., BRANDT u. RATZEBURG *Med. Zool.* II. Tab. XVI. figs. 4, 5 (*Meloë tecta* HELLW., PANZER *Deutschl. Ins.* Heft 10, Tab. 14, male, *Meloë punctulata* PANZER, ibid. Tab. 16, male); black, commonly glancing into steel-coloured violet, with deeply impressed points on the head and thorax; this species differs much in size.—Comp. on this genus LEACH *British species of the genus Meloë, Trans. of the Linn. Soc.* Vol. XI. 1815, pp. 35—48, Tab. V. VI., and his *Further Observat. with the descr. of six exotic species,* ibid. pp. 242—251, Tab. XVIII.; J. F. BRANDT et W. F. ERICHSON *Monographia gener. Mel., Nov. Act. Acad. Cæs. Leop. Car.* XVI. P. I. pp. 101—142, Tab. VIII.—NEWPORT *Nat. Hist. Anat. and Developm. of the Oil-beetle, Trans. Linn. Soc.* Vol. XX. p. 297, Vol. XXI. P. 2, p. 167.

†† *Body winged. Elytra not shorter than abdomen.*

a) *Antennæ with eleven joints.*

*Lytta* FABR., *Cantharis* GEOFFR., OLIV., LATR. Antennæ straight, filiform, longer than head and thorax. Body oblong.

α) *With penultimate joint of tarsi entire.*

*) *With elytra at the apex attenuated, subulate, dehiscent.*

*Sitaris* LATR. (*Apalus* FABR.[1])

**) *With elytra covering the whole abdomen above, not attenuated.*

Sub-genera: *Gnathium* KIRBY, *Nemognatha* ILLIG., LATR., (with external process of maxillæ filiform, exsert), *Zonitis* FABR., *Tmesidera* WESTW., *Cantharis* LATR.

Sp. *Lytta vesicatoria, Meloë vesicatorius* L., GEOFFR. *Ins.* I. Pl. VI. fig. V., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 10, fig. 6, BRANDT u. RATZEBURG *Mediz. Zool.* II. Tab. XVIII. figs. 1—6, &c. *Spanish Fly;* green gold-glancing, with black antennæ, a broad head, channelled above, thorax quadrangular, broader forwards, length 10‴. The blistering power of this insect renders it very important as a remedy in medicine. Other species also of the *Meloëidæ* possess the same property, which however, as is asserted, is not perceived in *Apalus*. The female lays her eggs in the ground; the larvæ make their appearance after about three weeks, like those of *Meloë* (and of *Apalus*, which are quite similar to them according to GENÉ), hitherto known in the first period of their life alone, but not in their further growth.

Compare C. A. LENÆUS, *Meloë vesicatorius, Diss.*, in C. LINNÆI *Amœnit. Acad.* VI. pp. 132—147; LOSCHGE *Beiträge zur Gesch. der Spanischen Fliege, Naturforscher* XXIII. 1788, s. 37—48, Tab. I, figs. 1—8;—AUDOUIN *Recherches pour servir à l'Histoire nat. des Cantharides, Ann. des Sc. natur.* IX. 1826, pp. 31—61, Pl. 42, 43 (anatomical description); BRANDT u. RATZEBURG l. l. pp. 116—121 and Pl. XIX.; RATZEBURG *Forst-Ins.* X. I. pp. 88—92 &c.

β) *With penultimate joint of tarsi bilobed.*

*Tetraonyx* LATR.

Comp. LAPEIRLLE in HUMBOLDT et BONPLAND *Observ. de Zoolog. et d'Anat.* Comp. I. pp. 160—162, Pl. XVI. fig. 7.

*Œnas* LATR. Antennæ not longer than thorax or scarcely as long, geniculate, with first joint elongate, obconical, the rest broad, short, the last oval.

Sp. *Œnas afer, Lytta afra* FABR., LATR. *Gener. Crust. et Ins.* Tab. X. fig. 10, CUV. *R. Ani. éd. ill., Ins.* Pl. 54, fig. 9.

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[1] J. GENÉ, *Mémoire pour servir à l'Hist. nat. de l'Apalus bimaculatus et des Cantharides en général. Ann. des Sc. nat.* XXIII. pp. 138—144. 1831.

*Mylabris* FABR. Antennæ short or scarcely of the length of thorax, towards the extremity incrassated gradually into an elongate club, arcuate.

Compare G. J. BILLBERG *Monographia Mylabridum*, Holmiæ, 1813, 8vo; SCHOENHERR *Syn. Ins.* I. 3, pp. 30—43; F. GEBLER *Des Mylabrides de la Sibérie &c. Nouveaux Mém. de la Soc. impér. de Moscou*, I. 1829, pp. 147—171.

Sp. *Mylabris cichorii* FABR., *Meloë Cichorii* L., BRANDT u. RATZEB. *Mediz. Zool.* II. Tab. XVIII. fig. 17, from China, East Indies. Other species are often confounded with this, as *Mylabris Fuesslini* PANZER *Deutschl. Ins.* Heft 31, Tab. 18, *Mylabris variabilis* BILLB. &c.

*Lydus* MEGERLE (with external claws of tarsi pectinate). Sp. *Mylab. trimaculata* BILLB., BRANDT u. RATZEB. *Med. Zool.* II. pp. 126, 127, Tab. XVIII. fig. 16.

b) *Antennæ with eight or nine joints, clavate at apex, last joint large, oval.*

*Hycleus* LATR.

*Arithmema* CHEVROL.

Sp. *Arithmema decemguttata* CHEVR., GUÉRIN *Iconogr., Ins.* Pl. 35, fig. 2, pp. 131, 132.

*Cerocoma* GEOFFR., SCHÆFF.

Sp. *Cerocoma Schæfferi* FABR., *Meloë Schæfferi* L., GEOFFR. *Ins.*, I. Pl. 6, fig. 9, SCHÆFFER *Elem. Entom.* Tab. 37, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 10, fig. 7, &c.

Phalanx II. *Mordellona* (*Mordellidæ* LEACH). Antennæ short, very often serrated. Elytra hardish. Thorax gibbous. Body compressed. All the tarsi or those of posterior feet with joints entire. Claws of tarsi mostly bifid, with the superior divisions pectinate. (Genus *Mordella* L.)

*Rhipiphorus* BOSC., FABR., LATR. Thorax produced posteriorly between elytra; scutellum concealed. Elytra abbreviate, or angustato-acuminate, dehiscent. Antennæ pectinato-serrate, in males flabelliform. Palps subfiliform. Maxillæ with external lacinia long, linear.

Sp. *Rhipiphorus paradoxus* FABR., *Mordella paradoxa* L., PANZER *D. Ins.* 26, Tab. 14;—*Rhipiphorus bimaculatus* FABR., DUMÉR. *Cons. gén. s. l. Ins.* Pl. 11, fig. 4, &c. Comp. on some new species FISCHER in *Bullet. de la Soc. impér. des Natural. de Moscou*, IV. 1832, p. 426, Tab. V.

Sub-genera: *Myodites* LATR., *Ripidius* THUNB. (*Symbius* SUNDEV.), *Macrosiagon* HENTZ, *Pelocotoma* FISCH., *Evaniocera* GUÉRIN (with scutellum distinct).

Comp. HENTZ *Trans. of the American philos. Soc., new Series*, Vol. III. Pt. 2, pp. 462, 463. Pl. XV. f. 3. *Macrosiagon dimidiatum* (*Rhipiphorus dimidiatus* FABR.), SUNDEVAL in OKEN'S *Isis*, 1831, s. 1222—1228, Tab. VIII. *Symbius Blattarum*. (The larva lives in *Blattæ* after the manner of Ichneumons.)

*Mordella* LATR. Scutellum distinct. Elytra narrowed posteriorly, not shorter than abdomen. Antennæ filiform, subserrate. Maxillary palps with last joint large, obconical.

Sp. *Mordella aculeata* L., GEOFFR. *Ins.* I. Pl. 6, fig. 7, SCHÆFFER *Elem. Entom.* Tab. 84, &c.

*Anaspis* GEOFFR., LATR. Antennæ thicker towards apex, subfiliform, not serrate. Penultimate joint of tarsi of four first feet bilobed. Remaining characters those of the preceding genus.

Sp. *Anaspis frontalis*, *Mordella frontalis* L., PANZER *Deutschl. Ins.* Heft 13, Tab. 13; variety *Anaspis atra* DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 11, fig. 6, &c.

Phalanx III. *Horiatia* (*Horiidæ* WESTWOOD). Antennæ filiform, moniliform or subserrate, short. Tarsi with joints undivided, furnished with claws denticulate beneath, and with double filiform appendage. Mandibles strong, exsert; palps filiform. Thorax broad, transverso-quadrate. Head nutant. Feet short, posterior with femora incrassated, especially in males. Elytra soft, dehiscent at the apex.

*Horia* FABR.

* *Head narrower than thorax. Antennæ longer than thorax.* Sub-genus *Cissites* LATR. (*Gener. Crust. et Ins.* 2, p. 212, previously *Horia* ejusd. *Hist. nat. des Crust. et Ins.* X. p. 364).

Sp. *Horia testacea* FABR., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 12, fig. 6, J. G. HUEBNER *Beitr. z. Naturg. d. Ins.* in *Naturforscher* 28, p. 47, Tab. II. figs. 14—17, from East Indies.

** *Head tumid behind the eyes, of the breadth of thorax. Antennæ scarcely longer than thorax. Horia* LATR. (previously *Cissites* ejusd.)

Sp. *Horia maculata* FABR., CUV. *R. Ani. ed. ill., Ins.* Pl. 54, fig. 4, from S. Amer. The larva lives parasitically in the cells of the larvæ of *Xylocopa*; on the metamorphosis cons. LANSDOWN GUILDING *Trans. of the Linn. Soc.* Vol. XIV.

Phalanx IV. *Pyrochroïdea* nob. Antennæ filiform or gradually thicker towards the apex, subserrate, in some pectinate, longer than head and thorax. Tarsi with penultimate joint bilobed, with claws undivided, not denticulate. Maxillary palps with last joint large, truncated, obtrigonal. Mandibles broad, short.

We unite in this group the *Anthicides* (*Notoxidæ* STEPHENS, WESTW.), the *Pyrochroïdes* and *Lagriariæ* of LATREILLE, which are all closely allied.

*Notoxus* GEOFFR., OLIV. (*Anthicus* FABR.). Antennæ filiform with joints obconical, the last oval, longer. Maxillary palps with last joint large, securiform. Head nutant, broader than thorax. Thorax elongate, broader anteriorly, often constricted in the middle.

a) *With thorax anteriorly porrect into a horn.* (*Notoxus* ILLIG., *Monoceros* MEGERLE, DÉJ.)

Sp. *Notoxus monoceros*, *Meloë monoceros* L., GEOFFR. *Ins.* I. Pl. 6, fig. 8, DUMÉR. *Cons. gén. s. l. Ins.* Pl. 10, fig. 3, PANZER *D. Ins.* Heft 26, Tab. 8, &c.

b) *With thorax unarmed.*

Sp. *Notoxus antherinus*, *Meloë antherinus* L., PANZER *D. Ins.* Heft 11, Tab. 14, &c.

*Steropes* STEV.

*Scraptia* LATR.

*Note.*—A genus to be referred perhaps to the *Serropalpides* (v. supra, p. 491): this is scarcely its place.

*Pyrochroa* GEOFFR. Antennæ rather long, in males serrate or pectinate. Body elongate, narrower anteriorly, with thorax suborbicular or trapezoidal. Maxillary palps subserrate, terminated by a longer obtrigonal joint; labial palps filiform. Abdomen rounded posteriorly.

*Pogonocerus* FISCH. (*Dendroïdes* LATR.)

*Pyrochroa* LATR.

Sp. *Pyrochroa rubens* FABR., *Lampyris rubens* SCHALLER, GMEL., PANZER *D. Ins.* Heft 95, Tab. 5, VOET *Coleopt.* II. Tab. 48, fig. 1; the body and thorax black beneath, the head, the upper surface of the thorax, and the elytra vermilion without spot; the perfect insect is found on flowers; the larva lives in decayed willow-wood.

*Note.*—Here should be referred, according to WESTWOOD, genus *Pytho* LATR., with body depressed, thorax narrowed posteriorly,

truncated, *with penultimate joint of tarsi entire*, unless it be preferred to count it with LATREILLE amongst the *Helopii*, and to place it before *Strongylium*, (see above, p. 492).

*Lagria* FABR. Antennæ inserted in a sinus of the eyes, filiform or gradually thicker towards the apex, with last joint longer than the rest. Palps both maxillary and labial thicker towards the extremity, maxillary longer than labial, with last joint transverse, truncated. Thorax narrow, cylindrical, subquadrate. Elytra much broader than thorax, dilated towards the apex, rounded, soft. Body very often villose or pubescent.

Sp. *Lagria hirta* FABR., *Chrysomela hirta* L., PANZER *D. Ins.* Heft 107, Tab. 2, CUVIER *R. Ani. éd. ill., Ins.* Pl. 53 bis, fig. 1; the larva, found by LYONET in winter under fallen oak-leaves, has very conspicuous antennæ projecting laterally; see LYONET *Recherches*, pp. 112—114. Pl. XI. figs. 17—31.

*Statyra* LATR.

Species all American, similar in habit to the *Carabici*, with thorax oval, truncated. Sp. *Statyra agroïdes* DÉJ., CUV. *R. Ani. éd. ill., Ins.* Pl. 53 bis, fig. 2. On this genus comp. SAINT-FARGEAU et SERVILLE *Encycl. méth., Ins.* Tom. X. pp. 479, 480; DÉJEAN enumerates 22 species of this genus; *Catalogue des Coléopt.* 1837, p. 236.

D. *Pentamera.* Tarsi all with five joints.

We here employ this character only in so far as it is available for the most of the genera, but not as absolutely universal and exclusive. Already LATREILLE was obliged to admit some exceptions (*Familles nat. du Règne animal*, 1825, p. 337); we subjoin still others, and do not separate, for instance, *Pselaphus* from the rest of the *Brachelytra*, whilst, on the other hand, we have placed the genera with five joints *Dacne*, *Episcapha*, and *Triplatoma* (see above, p. 470) with the *Tetramera* in the family of the *Clavipalpi*.

Family LVI. *Lamellicornia.* Antennæ clavate, short, mostly with nine or ten joints, inserted under the exsert margin of head. Club of antennæ lamellate, or serrate, or tunicate, with first joint of club infundibuliform, including the other joints. External margin of the two anterior feet dentate. Mentum often large, covering the ligula, and bearing palps.

*Lamellicorn beetles.* The insects of this group form in the system of LINNÆUS the genera *Lucanus* and *Scarabæus*. The larvæ are thick, cylindrical, the posterior part of the body bent down-

wards; besides the head there are thirteen rings; no eyes are present; the feet have four joints and a strong claw at the end. The pupæ, which lie in a hollow clod of earth, have the cases of the wings projecting beyond the posterior margin of those of the elytra. See the beautiful figures in the *Mém. sur les métamorphoses des Coléoptères* of W. De Haan, *Nouv. Ann. du Muséum* iv. 1835, pp. 125—164, pl. 10—19.

Phalanx I. *Lucanidea* or *Priocera*. Antennæ with ten joints, club pectinate, with lamellæ sub-parallel, and almost perpendicular to the axis. (Elytra always covering the apex of abdomen. Abdomen with only five distinct segments underneath.)

The larvæ live on decayed wood and reside in hollow stems of trees. This group is allied indeed to the following, but still differs by some anatomical characters. The larvæ have a nervous system, of which the ganglia of the thorax and the abdomen are separated from each other by considerable distances; whilst in the following group they lie very close together, forming as it were a varicose string. In the proper genus *Lucanus* the nervous system of the perfect insect has quite a different form from that of the *Scarabœida;* the second and third thoracic ganglia are separated from each other, and the abdomen has six distinct ganglia, whilst in the *Scarabœida* the second and third thoracic ganglia are fused together, and in the abdomen, in place of a chain of ganglia, a single central nervous mass alone succeeds to this thoracic ganglion, from which mass the nerves of the abdomen arise at acute angles (like the last spinal nerves in the *Cauda equina* of mammals).

See the figures of Blanchard *Ann. des Sc. nat., 3ième Série,* Tom. v. Pl. 8, fig. 1, in *Lucanus cervus,* and in Cuvier. *R. An. éd. ill., Ins.* Pl. 3, in the cockchafer. As perfect insect *Passalus* follows the *Scarabœida* in the form of the nervous system, and therefore is referred by Blanchard to this group, and separated from *Lucanus.*

A. *Ligula membranous, mostly bilobed and penicillate. Antennæ smooth, mostly broken, with first joint elongate. Scutellum between the base of elytra at the beginning of the suture.*

*Lucanus* L. (in part). Mandibles exsert beyond head, mostly much larger in males, porrect. Labrum mostly conjoined with clypeus or none. Maxillæ membranous. Antennæ broken. Feet often elongate, especially the anterior. Body somewhat depressed.

The *Stag-beetles.* The genus *Lucanus*, although from the characters given above much more limited here than with LINNÆUS, still contains different genera of modern authors which it is impossible for us to set forth here. The under jaws are commonly membranous; in the females alone of some exotic species the innermost lobe (*mando*) has a horny hooklet at the extremity[1]. In some species the eyes are completely divided by a projecting flat margin of the head into two, one situated on the upper and one on the under side of the head.

Comp. C. P. THUNBERG *Lucani Monographia, Mém. de la Soc. impér. de Moscou*, I. pp. 150—173. Pl. 12; MAC LEAY, *Horæ entomol.* 1819 (*Annulosa Javanica, édit. franç. Paris*, 1833, 8vo. pp. 11—29); J. O. WESTWOOD *Descriptio gener. novor. e fam. Lucanid., Ann. des Sc. nat.* 2e Série, I. 1834, pp. 112—127, Pl. 7; BURMEISTER *Handb. der Entom.* V. 1847, s. 311—442.

*Lucanus* LATR. (and *Platycerus* ejusd. in part).

Sp. *Lucanus cervus* L., *Stag-beetle, cerf volant, Hirsch-käfer, Schröter, het vliegend hert*, &c., RŒSEL *Ins.* II. *Scar. terr.* Cl. I. Tab. IV. V., VOET *Coleopt.* I. Tab. 29, figs. 1, 2, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 5, fig. 1; dark-brown (like old mahogany); the male is larger than the female, has the head broader than the thorax, and branched upper jaws about the length of head and thorax together, these included it is full 2½″ long; in the female the upper jaws are less than the head. The size, however, varies much; a constantly smaller variety is *Lucanus capreolus* FABR. (not L.), VOET, l. l. figs. 3, 4, SULZER *Abgek. Gesch. d. Ins.* Tab. II. fig. 1, which is found with the ordinary one. (*Lucanus capreolus* L. is a N. American species, which FABRICIUS names *Lucanus dama.*) The metamorphosis of the stag-beetle is described by RŒSEL. The larva is pale yellow, becomes very large, and lives some years; it lives in decaying oak-trees. The perfect insect makes its appearance in June and July.

*Chiasognathus* STEPHENS. Club not abruptly distinct, with six lamellæ. (Eyes always divided into two parts by the margin of head, as by a septum.)

Sub-genera: *Chiasognathus* STEPHENS (antennæ of males with a whorl of hairs before the club), *Sphærognathus* BUQUET. Mandibles of males in both these sub-genera longer than thorax, sometimes of the length of body. Sp. *Chiasogn. Grantii, Tetrophthalma Chiloënsis*, LESSON *Illust. de Zool.* Pl. 24, *Dict. univ. d'Hist. nat., Ins. Coléopt.* Pl. 7, fig. 3;—*Sphærogn. prionoïdes* BUQUET, GUÉRIN *Magas. de Zool.* 1839, *Ins.* Pl. 1; *Sphærogn. Feisthamelii* GUÉRIN ibid. 1840, Pl. 39. Species from S. America.

*Ryssonotus* MAC L. Mandibles thick, with external margin unidentate. Sp. *Luc. nebulosus* KIRBY, from New Holland.

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[1] WESTWOOD, *Annals of Nat. History*, VIII. 1842, pp. 121—123.

*Lamprima* LATR., SCHOENH. Labrum distinct, exsert. * Club of antennæ with three lamellæ. Internal lacinia of maxillæ in females terminate by a horny hook. (Head small, narrower than thorax.)

Sub-genera: *Lamprima* LATR. (Sp. *Lampr. fulgida, Lampr. ænea* GUÉRIN *Iconogr., Ins.* Pl. 27, fig. 2, CUV. *R. Ani. ed. ill., Ins.* Pl. 45 bis, fig. 3; (anterior tibiæ of males with terminal spine broad, obtrigonal);—*Pholidotus* MAC LEAY. (Sp. *Lamprima Humboldti* GYLLENH., SCHOENH. *Synon.* I. 3, Append. p. 197, GUÉRIN *Iconogr., Ins.* Pl. 27, fig. 6, &c.

*Syndesus* MAC L. Mandibles exsert beyond the head. Labrum connate with clypeus. Maxillæ membranous. Antennæ short, not broken, club with six or seven joints. Eyes large, globose, undivided. Posterior feet very remote from preceding. Body cylindrical.

Sp. *Syndesus cornutus, Sinodendrum cornutum* FABR., CUV. *R. Ani. éd. ill., Ins.* Pl. 45 bis, fig. 8; habit. in *Van Diemen's Land.*

*Note.*—Genus *Hexaphyllum* GRAY, WESTW. (*Psilodon* PERTY) is rightly joined with genus *Syndesus* by BURMEISTER.

*Figulus* MAC L. (and *Nigidius* ejusd.). Mandibles little exsert. Internal lacinia of maxillæ armed with a horny tooth. Labrum exsert, mobile. Antennæ broken, club with three lamellæ. Lateral margin of head extending beyond the eyes, and dividing them in great part or entirely.

Sp. *Figulus striatus* WESTWOOD, BLANCHARD *Hist. d. Ins.* Paris, 1845, Pl. 8, figs. 1—3 (*imago, larva, nympha*); hab. in island of Mauritius, &c.

*Note.*—Add sub-genera *Xiphodontus* WESTW. and *Agnus* BURM.

*Sinodendrum* FABR. Labrum exsert, free. Mandibles scarcely produced beyond clypeus. Maxillæ membranous, ciliated, with internal process acuminate. Antennæ scarcely broken, short, with club three-leafed. Body cylindrical.

Sp. *Sinodendrum cylindricum, Scarab. cylindricus* L., DE GEER *Ins.* IV. Pl. 10, figs. 2, 3, PANZER *D. Ins.* Heft 1, Tab. 1, Heft 2, Tab. 9, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 5, fig. 3; this insect is found in many countries of Europe; the larva lives in beeches, oaks, &c. The male has a horn on the head, like many *Scarabæida.*

*Æsalus* FABR. Labrum exsert, free. Mandibles produced beyond clypeus. Maxillæ membranous. Antennæ not broken, club three-leafed. Body short. Feet moderate or short.

Sp. *Æsalus scarabæoïdes* FABR., GUÉRIN *Iconogr., Ins.* Pl. 27, fig. 2.

Add genera *Ceratognathus* WESTW. (and *Mitophyllus* PARRY), *Ceruchus* MAC L., (*Lucan. tenebroïdes* FABR., species of *Platycerus* LATR.)

B. *Ligula horny. Antennæ pubescent, arcuate. Thorax quadrate, separated by stricture from abdomen. Scutellum in the peduncle of abdomen, beyond the base of elytra.*

*Passalus* FABR. (species of *Lucanus* L.). Labrum transverse, emarginate, ciliated. Mandibles broad, armed with thick teeth. Maxillæ horny, slender, with external lacinia incurved, acuminate, internal shorter, bidentate. Body depressed, mostly oblong. Feet short.

P. ESCHSCHOLTZ *Diss. de Coleopterorum genere Passalus, Nouv. Mém. de la Soc. imp. de Moscou*, I. pp. 13—23, *Ann. des Sc. nat.* XXII. pp. 332—336; PERCHERON *Monographie des Passales*, Paris, 1835, 8vo. av. 7 pl. and his supplements to this in GUÉRIN *Magasin de Zool.* 1841 and 1842.

Sp. *Passalus interruptus* FABR., *Lucanus interruptus* L., VOET *Coléopt.* I. Tab. 29, fig. 1, S. America;—*Pass. pentaphyllus* GUÉRIN *Iconogr., Ins.* Pl. 27, fig. 7, &c. To this genus belong very many species, nearly all agreeing in form, and coloured brown or black; they are in great part found in S. America and the islands of the Indian Archipelago and South Sea; in Europe and North Africa none of them are found. The larva has much resemblance to that of *Lucanus*, but the last pair of feet is replaced by two small conical tubercles, as was first remarked by PERCHERON. BURMEISTER gave a more complete description of the larva and the pupa in his excellent *Handbuch d. Entomol.* V. S. 454, 459.

*Note.*—To this family of insects genus *Trictenotoma* GRAY was formerly referred by English authors. Now, however, it is more correctly referred to the *Longicornia* by DUPONT and also by WESTWOOD, where it is to be placed after genus *Prionus* (above, p. 480) as an anomalous genus. By the number of joints of the tarsi it belongs to the *Heteromera*. Antennæ longer than head and thorax, eleven-jointed, with first joint elongate, three last incrassate, forming internally a sub-serrate club.

Sp. *Trictenotoma Childreni* GRAY, DUPONT, GUÉRIN *Magas. de Zool.* 1832, *Ins.* Pl. 32, from Java. WESTWOOD has lately added two other species from the East Indies, *Cabinet of oriental Entomol.* 1848, Pl. 23.

Phalanx II. *Scarabæidea* or *Petalocera*. Club of antennæ lamellate or tunicate.

These insects form with LINNÆUS the genus *Scarabæus*. They compose one of the most numerous divisions of the *Coleoptera*,

which amongst the *Pentamera*[1] is surpassed by the *Carabici* alone. Many large species belong to it, which are armed with knobs, horns and other excrescences on the head or thorax. As the horns amongst the ruminant mammals are often appropriated to the male individuals, so here also these excrescences are mostly wanting in the females, or much less developed. These insects live for the most part on plants, some on decaying parts of vegetables or on animal dung. The larvæ live long; some change into nymphs only after three or four years. The intestinal canal of the perfect insect is commonly very long, and the stomach forms the chief part of it, (see above, p. 253). The vessels for secreting urine are long, four in number, and so much convoluted round the intestinal canal that their termination is found with difficulty. In the larvæ the stomach is short, wide, and surrounded by three rings of blind appendages, which however are wanting in the larvæ of *Aphodius*, (De Haan *Nouv. Ann. du Mus.* iv. pl. 18, fig. 4). The small intestine is very short, and the large extensive and wide, filling the whole space of the body behind. The air-tubes of the perfect insect form, especially in the abdomen, many larger or smaller vesicular expansions, by which these animals, notwithstanding their size, are often very light, which increases their capacity for flying.

Compare on the division of this group Mac Leay *Horæ entomologicæ* and Burmeister *Handb. der Entomol.* iii. pp. 93—117.

A. *Melitophila.* Abdomen longer than head and thorax, with last segment (*pygidium*) produced beyond the truncated elytra. Ligula connate with mentum. Mandibles membranous internally. Antennæ ten-jointed, with club three-leafed.

Comp. H. Gory and A. Percheron *Monographie des Cétoines et genres voisins*, Paris, 1833, 8vo. (with 77 col. pl.), and H. R. Schaum *Analecta entomologica.* Cum tab. ænea. Halis Saxonum, 1841, 8vo. pp. 32—49.

*Cetonia* Fabr. Elytra on the outer margin sinuate or excised. A little triangular part on each side of thorax before elytra (epimeron of mesothorax eminent, conspicuous). Mesosternum terminating anteriorly in a process between the base of middle feet. Scutellum distinct, mostly conspicuous, large, triangular, in some covered by a lobe of thorax.

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[1] In the third edition of the *Catalogue des Coléoptères de la Collection de M. le Cte.* Déjean are enumerated nearly 2300 species.

A very natural, though numerous genus. The excision of the shield-covers next the hind feet leaves generally a part of the margin of the abdomen visible; the wings, since the insect flies with closed elytra, pass through the excision.

Sub-genera: *Goliathus* LAM. (in part), *Gymnetis* MAC L., *Cetonia*, *Cremastochilus* KNOCH. (Add other sub-genera proposed by GORY and PERCHERON, BURMEISTER and others.)

Sp. *Cetonia Cacicus* FABR., *Goliathus cacicus* LAM., VOET *Coleopt.* I. Tab. 22, fig. 151, GORY et PERCH. *Monogr.* Pl. 24, *Dict. univ. d'Hist. nat., Atlas, Coleopt.* Pl. 6; West coast of Africa, Sierra Leone, &c., as also the rare and large species *Cet. goliata*, *Scarabæus Goliathus* DRURY, *Exotic Ins.* Tom. III. Pl. 40 (copied by OLIVIER *Coleopt.* I. No. 6, Tab. V. fig. 33, Dutch edition of STURM, Tab. 70), CUV. *R. Ani. ed. ill., Ins.* Pl. 45, fig. 4.

(*Gymnetis* MAC L.) Sp. *Cetonia holosericea* FABR., VOET *Coleopt.* I. Tab. II. fig. 10, S. America, Surinam;—*Cetonia nitida*, *Scarab. nitidus* L., VOET 2. Tab. 3, fig. 23, CUV. *R. Ani. éd. ill., Ins.* Pl. 45, fig. 5.

*Cetonia aurata* FABR., *Scarab. auratus* L., RŒSEL *Ins.* II. *Scarab. terr.* Cl. I. Tab. II. figs. 1—3, fig. 9, PANZER *D. Ins.* Heft 41, Tab. 15; the *golden beetle*, gold-green, elytra spotted white, 7‴ to 9‴ long; common in gardens upon roses, elder, *Thalictrum*, &c. The larva is often found in ants' nests.—*Ceton. ænea* GYLLENB., *Ceton. floricola* HERBST &c.

*Trichius* FABR. Elytra with external margin not excised; epimera mostly not conspicuous in front of elytra. (Thorax suborbicular in most; scutellum often small.)

Compare LEPELETIER et SERVILLE *Encycl. méth., Ins.* Tom. X. pp. 701—764.

Sp. *Trichius abdominalis* DEJ., ERICHS. (and *Trichius gallicus* DEJ.), *Trichius fasciatus* LATR., GORY et PERCHERON *Monogr.* Pl. 10, fig. 1, VOET *Coleopt.* I. Tab. V. fig. 43, HOUTTUYN *Nat. Hist.* I. 9e Stuk, Tab. 72, fig. 8, CUV. *R. Ani. éd. ill., Ins.* Pl. 45, fig. 1; this species is different from the true *Trichius fasciatus* L. (see GYLLENHAL in *Append.* to SCHOENH. *Syn.* Tom. 3), which I have not observed here; the *Trichius fasciatus* L. is *Trichius succinctus* LATR. (not *Scar. succinctus* PALL.), GORY et PERCHER. *Monogr.* Pl. 10, fig. 2;—*Trichius hemipterus* FABR., *Scarab. hemipterus* L., VOET *Coleopt.* I. Tab. X. figs. 88—90.

Add genus *Inca* LEPEL. et SERV. (species of *Cetonia* FABR.), and some others of modern writers. Here also belongs, in BURMEISTER'S opinion, genus *Euchirus* KIRBY.

Sp. *Euchirus longimanus*, *Scarab. longimanus* VOET *Coleopt.* I. Tab. XI. fig. 97, HOUTTUYN *Nat. Hist.* I. 9e Stuk, Tab. 72, fig. 3; habit. in East India (Bengal). See other species figured in WESTWOOD *Oriental Entomology*, Tab. 1 and 13.

B. *Anthobia* (*Glaphyridæ* MAC L.). Elytra shorter than abdomen, mostly dehiscent towards the apex. Last dorsal segment of abdomen (*pygidium*) surpassing elytra. Antennæ with nine or ten joints, club three-leafed. Mandibles horny, membranous on the inner side alone. Maxilla with process membranous, often elongate and hirsute. Ligula free, membranous, bipartite, produced beyond the horny mentum.

A small group of beetles, of which FABRICIUS brought the species known to him to the genus *Melolontha*, but which has just as much affinity to *Trichius*. Most of the species are from the old world, especially from the south of Africa, some are met with also in the south of Europe (Italy, Portugal). Some species are very hairy; in some the males are distinguished by very long hind-feet with thick thighs; the hooklets of the four first feet are mostly bifid. Most of the species are small, between 3‴ and 5‴; only few are half an inch or more in size.

*Pachycnema* LEPEL. et SERV.

Sp. *Pachycnema crassipes*, *Melol. crassipes* FABR., GUÉRIN *Iconogr., Ins.* Pl. 25 bis, fig. 6; habit. Cape of Good Hope, &c.

*Anisonyx* LATR.

Sp. *Anisonyx ursus*, *Mel. ursus* FABR., VOET *Coleopt.* I. Tab. 5, fig. 35; habit. Cape of Good Hope.

*Amphicoma* LATR.

Sp. *Amphicoma bombyliformis*, *Melol. bombyliformis* FABR., GUÉRIN *Iconogr., Ins.* Pl. 25 bis, fig. 2; habit. in southern Russia, &c.

*Glaphyrus* LATR.

Sp. *Glaphyrus maurus*, *Scar. maurus* L. &c.

Add genera *Lichnia* and *Cratoscelis* ERICHSON. Species from South America (Chili) with eyes bipartite, claws of tarsi as in *Glaphyrus* and *Amphicoma* equal, antennæ nine-jointed.

See WIEGMANN'S *Archiv.* 1835, I. pp. 267—270, Tab. III. On other genera of this subdivision consult BURMEISTER *Handb. der Entom.* IV. pp. 1—67.

C. *Phyllophaga* LATR. (with the addition of a part of *Xylophili* ejusd., *Melolonthidæ*, *Anoplognathidæ* and *Rutelidæ* MAC L., WESTWOOD). Elytra shorter than abdomen, with pygidium free. Antennæ with eight to ten joints, club with three to seven. Mandibles horny as to the greatest part, furnished internally with a lamina membranous, ciliated, with a large tooth at the base.

Ligula horny, immoveable, connate with mentum. Labrum mostly exsert, horny.

These beetles in the perfect state live in great part on leaves, the larvæ on the roots of all kinds of plants.

*Rutela* LATR. Labrum exsert, mostly descending. Mandibles horny, exsert, with external margin often somewhat prominent, crenulate or dentate. Maxillæ with several teeth at the apex. Antennæ with ten joints, club three-leafed. Feet thick, with claws of tarsi unequal, incurved.

*Areoda* LEACH, *Chrysophora* DÉJ., *Pelidnota* MAC L., *Rutela* MAC L., *Macraspis* MAC L., *Chasmodia* MAC L., and some other sub-genera, on which see BURMEISTER *Entom. Handb.* IV. 1, pp. 330—429.

Sp. *Rutela chrysochlora* LATR., *Chrysophora chrysochlora* DÉJ., HUMBOLDT et BONPLAND, *Observ. de Zool. et d'Anat. comp.* I. Pl. XV. figs. 1, 2, GUÉRIN *Iconogr., Ins.* Pl. 24, fig. 1; Peru; hind feet in male long, with broad thighs, and tibiæ terminating in a triangular process turned inwards. Without having this process the hind feet in the male of *Scarabæus macropus* FRANCILLON, SHAW, *Chrysophora macropa* DÉJ., are in like manner very strongly developed.

*Rutela lineola* LATR., *Scarabæus* (*Surinamus* and) *lineola* L., *Cetonia lineola* FABR., VOET *Coleopt.* I. Tab. IX. fig. 81; Surinam, Brazils.—*Rutela splendida* SCHOENH., *Cetonia splendida* F., VOET *Coleopt.* I. Tab. VIII. fig. 62, &c.

All the species of this genus are exotic; the most are found in South America; they have usually lively colours or a metallic lustre.

*Anomala* MEGERLE (*Euchlora* MAC L.). Mandibles with external margin rotundate, entire. Antennæ with nine joints. (Other characters of the preceding genus; feet less thick, with external claw of four anterior feet mostly bifid.)

Sp. *Anomala Frischii* (*Melol. Frischii* and *Mel. Julii* FABR.), PANZER *Deutschl. Ins.* Heft 97, Tab. 9, 10, RATZEBURG *Forst-Ins.* I. Tab. 3, fig. 10; 4‴ to 6‴ long, green with usually yellowish brown elytra; it differs, however, much in colour; see the accurate description and synonymy in ERICHSON *Naturgesch. der Ins. Deutschl., Coleopt.* III. 1847, s. 625—627.—*Anomala horticola, Scarab. horticola* L., *Melol. horticola* F., (*Anisoplia horticola* MEG., DÉJ., *Catal. des Coléopt.* 3e édit.), PANZER *Deutschl. Ins.* Heft 47, Tab. 15, RATZEBURG *Forst-Ins.* I. Tab. 3, fig. 9; 4‴ long, hairy, with brown-red shield-covers, steel-coloured blue thorax; very common.

*Anisoplia* MEGERLE, DÉJ. (in part). Clypeus angustato-produced, recurved.

Sp. *Anisoplia fruticola, Melol. fruticola* F., RATZEBURG *Forst-Ins.* I. Tab. 3, fig. 7; in the eastern part of the middle of Europe.

*Note.*—Sub-genera *Strigoderma* DÉJ., *Popilia* LEACH, *Mimela* KIRBY, *Rhinyptia* DÉJ. Compare BURMEISTER *Handb. der Entomol.* IV. 1, pp. 214—317.

*Anoplognathus* MAC L. (with the addition of some other species). Labrum porrect, descending, with middle portion acuminate, produced, touching mentum. Mandibles externally rotundate, concealed beneath labrum. Antennæ with ten or nine joints, club trifoliate.

Sub-genus: *Anoplognathus* MAC L. (and *Repsimus* LEACH). Tarsi simple, short, thick, with claws simple. Mesosternum elongate mucronate. Antennæ with ten joints.

Sp. *Anoplognathus viridi-æneus* MAC L., *Rutela Latreillii* SCHOENH., CUV. *R. Ani. éd. ill., Ins.* Pl. 42, fig. 3; from New Holland, like the other species of this sub-genus.

*Platycœlia* DÉJ.

Species American. Add sub-genus *Phalangogonia* BURM.

*Brachysternus* GUÉRIN (*Amblyterus* MAC L., *Anoplosternus* GUÉRIN &c.). Mesosternum not acuminate. Antennæ with ten joints.

*Adoretus* ESCHSCH. (*Trigonostoma* DÉJ.)

*Note.*—On this and other sub-genera see BURMEISTER *Handb. der Entom.* IV. 1, pp. 437—477.

*Geniates* KIRBY. Tarsi dilated, densely pilose beneath (in some species of anterior feet alone and only in males). Antennæ more often with nine, sometimes with ten joints. Mesosternum not mucronate. Claws of tarsi unequal, one mostly bifid, the other simple. Mentum in males mostly rough with close setæ.

Sp. *Geniates barbatus* KIRBY *Linn. Transact.* XII. Pl. 21, fig. 8, GUÉRIN *Iconogr., Ins.* Pl. 24 bis, fig. 3; habit. in Brazil like several species (all are American) of this sub-genus, to which are to be added the allied genera *Evanos* LAPORTE, *Leucothyreus* MAC L. and *Bolax* FISCHER (and *Loxopyga* WESTWOOD).

*Melolontha* FABR. (exclusive of some species). Labrum transverse, emarginate in the middle, mostly bilobed. Mentum horny;

ligula mostly horny, emarginate. Mandibles horny, triangular. Antennæ with from seven to ten joints, club with three lamellæ or more, which are mostly longer in males.

*Hoplia* ILLIG., LATR. Mandibles with broad membranous border internally. Antennæ with nine or ten joints, club trifoliate. Claws of tarsi unequal, posterior feet often with claw single, strong. Body squamose.

Sp. *Hoplia philanthus* LATR., *Hoplia argentea* FABR., PANZER *Deutschl. Ins.* Heft 28, Tab. 18, RATZEBURG *Forst-Ins.* I. Tab. 3, figs. 14, 15, &c.

*Note.*—Here are to be inserted several genera of more modern writers, *Monochelus* ILLIG., *Gymnoloma* DÉJ. &c.; on which consult BURMEISTER *Handb. der Entomol.* IV. 1, pp. 84—202.

*Serica* MAC L., *Omaloplia* MEG., DÉJ. Labrum connate with clypeus. Mandibles with broad membranous border internally. Claws of tarsi equal, bifid.

Sp. *Serica brunnea, Scarabæus brunneus* L., *Melol. brunnea* FABR., VOET *Coleopt.* I. Tab. VII. fig. 53, PANZER *Deutschl. Ins.* Heft 95, Tab. 7, RATZEB. *Forst-Ins.* I. Tab. 3, fig. 12, &c.

*Note.*—Add sub-genera *Astæna, Symmela, Athlia* ERICHSON, *Abtabera* DÉJ., and some others omitted here.

*Melolontha* LATR. (and *Rhizotrogus* ejusd.) Labrum distinct from clypeus, descending obliquely backwards. Mandibles with narrow membranous border internally. Claws of tarsi equal, mostly denticulate near the base.

*a*) Club of antennæ trifoliate. Claws of tarsi supplied with a sharp denticle at the base. *Rhizotrogus* LATR. Antennæ with ten joints, *Amphimallus* LATR., MULSANT. Antennæ with nine joints. Sp. *Melol. solstitialis* FABR., *Scarab. solstitialis* L., VOET *Col.* I. Tab. VI. fig. 51, RATZEBURG *Forst-Ins.* I. Taf. III. fig. 5; brown, hairy, 7‴—8‴ long.

*b*) Club of antennæ in males 5—7, in females 4—6 jointed. (*Anoxia* LAPORTE, *Polyphylla* HARRIS, ERICHSON, *Melolontha* ERICHSON.)

Sp. *Melolontha fullo, Scarab. fullo* L., RŒSEL *Ins.* IV. Tab. XXX, VOET *Coleopt.* I. Tab. VI. figs. 48, 49, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 4, fig. 6; *de dwinkever, le foulon, grosser Julius kever, Dünenkäfer, the Fuller;* 15‴ long; antennæ of male with seven long leaves at the end, those of female with only five shorter; blackish brown and sometimes red-brown, with white irregular spots on the shield-covers, as though marbled; scutellum almost entirely white.

*Mel. vulgaris, Scarabæus melolontha* L., RŒSEL *Ins.* II. *Scar. terr.* Ct. I. VOET *Coleopt.* I. Tab. VI. figs. 45, 46; *de meikever, le hanneton, der Maikäfer, the Cockchafer;* nearly one inch long; the male with seven

leaves at the club of antennæ, the female with six shorter; thorax black with a white felt; stone-coloured or red-brown shield-covers. The larva lives three years underground, and destroys the roots of plants; in the autumn of the fourth year it changes into a nymph, from which the beetle, that lives on leaves of all kinds of trees, after some weeks makes its appearance, but commonly continues under ground until May. This insect in some years appears in large numbers, and causes dreadful damage, as for instance, according to the newspapers, in 1836, around Quedlimburg, where, in the middle of May, 132 Dutch *mud* (of four bushels) were collected. Another species, somewhat smaller, with reddish-brown thorax, of the same colour as the shield-covers, *Melol. Hippocastani* FABR. (PANZER *Deutschl. Ins.* Heft 97, Tab. 6, RŒSEL l. l. figs. 9, 10) is met with in this country in some years as well as the former, and sometimes in no fewer numbers. Compare on the cockchafer SUKOW *Naturgesch. des Maikäfers (aus dem 12ten Stück der Verhandl. des Badischen Landwirtsch. Vereins)* Carlsruhe 1824, (with an anatomical description of the larva and beetle), and STRAUS DURCKHEIM *Cons. gén.* &c.

D. *Xylophila* (*Xylophili* LATR. in part, *Dynastidæ* MAC L., WESTW.). Elytra shorter than abdomen, with pygidium free. Antennæ short, mostly with ten (more seldom eight or nine) joints, with club lamellate, always with three joints. Mandibles principally horny, produced at the apex beyond the clypeus, armed with a tooth at the base, mostly supplied internally with a border membranous, ciliated, narrow. Ligula horny, connate with mentum. Labrum covered by clypeus. Claws mostly equal (except those of anterior tarsi in males of some species). Scutellum distinct, moderate or small, broad, triangular, with apex rotundate.

These insects often present a great difference of form in the two sexes, the head and thorax in the male being armed with horny excrescences, which in the female are less developed or entirely absent. They are usually brown or black in colour; some exotic species are amongst the largest of beetles. The larvæ live in decaying wood and in garden mould.

† *Clypeus broad, mostly rotundate or subsinuate. Head of both sexes unarmed, or supplied with a small tubercle, never horned.*

*Hexodon* OLIV., FABR. Mandibles not crenate exteriorly. Body sub-orbicular. Elytra dilatato-marginate. Head small, with eyes minute.

Sp. *Hexodon reticulatum* OLIV., GUÉRIN *Iconogr., Ins.* Pl. 23, fig. 6; habitat Madagascar.

*Pachylus* DÉJ., BURM.

*Cyclocephala* LATR. Mandibles not crenate exteriorly. Body oval. Elytra not dilated. Anterior tarsi in males mostly incrassated.

Species exotic, most from South America. FABRICIUS placed those known to him amongst the *Melolonthæ*. Sp. *Cycloc. melanocephala*, *Mel. melanocephala* FABR., VOET *Coleopt.* I. Tab. 9, fig. 80; *Cycl. undata*, *Mel. spilophthalma* HERBST, VOET *Coleopt.* I. Tab. 10, fig. 91.

*Note.*—Add genus *Chapelus* MAC L. and some other sub-genera described by BURMEISTER *Handb. d. Entom.* V. pp. 18—86.

†† *Clypeus narrow, often acute; mandibles at the sides of clypeus not covered, with external margin often crenate.*

*Scarabæus* LATR. (with the addit. of genera *Phileurus* ejusd. and *Oryctes* ILLIG.), *Geotrupes* FABR.

a) *Head not different in the sexes, never horned but either smooth or armed with one or two tubercles, gibbous. Thorax in males often tuberculate or horned.*

*Strategus* KIRBY.

Sp. *Scar. Alæus* L., VOET *Coleopt.* I. Tab. XVIII. fig. 122, Tab. XIX. fig. 128; habitat South America.

b) *Head different in the sexes, of male tuberculate or horned, of female obsoletely tuberculate or entirely unarmed.*

Sub-genera: *Phileurus* LATR., *Agaocephala* MANNERH., *Oryctes* ILLIG., *Scarabæus* LATR.

*Note.*—This section of the *Scarabæi* is indeed numerous, but the genera of modern writers, most of them artificial, scarcely seem to throw any light on the distinction of species and the natural arrangement. *Oryctes* indeed is distinguished by defect of teeth in the maxillæ, but there are species similar in habit with denticulate maxillæ, which cannot be separated from the *Oryctidæ* (genera *Stypotrupes* BURM., *Xyloryctes* HOPE). *Character non facit genus.*

Sp. *Scarabæus nasicornis* L., SWAMMERDAM *Bibl. Nat.* Tab. XXVII., RŒSEL *Ins.* II. *Scar. terr.* Cl. I. Tab. VI.—IX., PANZER *Deutschl. Ins.* Heft 28, Tab. 2; the *Rhinoceros-beetle*; found especially under bark in hot-beds.

*Scarab. Hercules* L., VOET *Coleopt.* I. Tab. XII. fig. 98, RŒSEL *Ins.* II, *Scar. terr.* Præf. Cl. I. Tab. A. 1. Tom. IV. Tab. V. fig. 3, from the West Indies, &c. These large beetles live on the sap that flows from wounded trees or roots; for that purpose they wound the bark with their horn, as the *Lucani* do with their jaws.

E. *Arenicolæ* (*Trogidæ* MAC L., WESTWOOD, and *Geotrupes* eorund.). Elytra covering the abdomen completely. Abdominal

stigmata situated in the membrane between the ventral and dorsal segments, all covered by the elytra. Ligula not distinct from mentum. Labrum horny, mostly exsert beyond clypeus. Mandibles horny. Antennæ with ten or eleven joints, club always trifoliate.

*A. Ventral segments of abdomen five.*

*Trox* FABR. Ligula covered by mentum. Antennæ with ten joints. Head small, nutant. Thorax transverse, with anterior angles produced. Elytra hard, posteriorly involute, inflected, rugose, often muricate in longitudinal rows.

Sp. *Trox arenarius* FABR., *Silpha scabra* L., PANZER *Deutschl. Ins.* Heft 97, Tab. 1;—*Trox sabulosus* L., *Scarab. sabulosus* L., STURM *Fauna, Ins.* II. Tab. 38. These insects rarely fly. There are species that have no wings, as *Trox horridus* F., from the Cape of Good Hope; they form the subgenus *Phoberus* MAC L.

*B. Ventral segments of abdomen six.*

*Hybosorus* MAC L. Ventral segments of abdomen connate, except the last free. Antennæ ten-jointed.

Sub-genera: *Phœochrous* LAP. (*Atimus* DÉJ.), *Chætodus* WESTWOOD, &c.

*Orphnus* MAC L.

*Geotrupes* LATR. Ventral segments of abdomen free. Antennæ with eleven joints, club perfoliate. Eyes divided by the margin of head. Mandibles horny, armed at the apex. Ligula bilobed, with laciniæ exsert beyond mentum. Body oval. Feet strong, with tibiæ spinose.

Sp. *Geotrupes Typhœus, Scarab. Typhœus* L., FABR., VOET *Coleopt.* I. Tab. XIX. figs. 124, 125, PANZER *Deutschl. Ins.* Heft 2, Tab. 23; black, the male with three horns on the thorax directed forwards.—*Geotr. stercorarius*, L., FABR., PANZER *Deutschl. Ins.* Heft 49, Tab. 1, STURM *Fauna, Ins.* I. Tab. VI. fig. *a.*—*Geotr. vernalis, Scar. vernalis*, &c.

Sub-genera: *Bulboceras* KIRBY, *Odontœus* MEGERLE and some others of modern to be inserted here.

*Lethrus* SCOPOLI, FABR. Ventral segments of abdomen free. Antennæ with eleven joints, club obliquely truncated, tunicate,

with ninth joint including the two following. Eyes bipartite by the margin of head. Mandibles horny, large, exsert, ending externally in a tooth incurved, obtuse, with internal side serrate towards the base. Thorax very broad. Body ovate, short. Elytra connate; only short rudiments of wings. Posterior feet remote.

Sp. *Lethrus cephalotes* FABR., PANZER *Deutschl. Ins.* Heft 28, Tab. 1, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 7, fig. 1; habit. in Austria and south of Russia.

F. *Coprophaga* (*Aphodiidæ* MAC L., WESTW., and *Scarabæidæ* eorund., *Coprides* LEACH, ERICHS.). Abdominal stigmata situated in the membrane between ventral and dorsal segments, all covered by elytra. Elytra entirely covering abdomen in some, truncated in others, not concealing the posterior part of pygidium. Ligula separate from mentum. Labrum membranous, covered. Mandibles membranous, ciliated. Antennæ with eight or nine joints, club always trifoliate.

*Copris* GEOFFR. Antennæ with eight or nine joints. Ventral segments of abdomen connate. Posterior tibiæ with single spur. Scutellum mostly indistinct or very small. Intermediate feet more remote from each other at their insertion than the rest, sometimes very distant.

*Note.*—Many species are without anterior tarsi; in some there is a sexual difference, so that this defect is peculiar to males. Compare BRULLÉ *Ann. des Sc. nat.* sec. Série, Tom. VIII. 1837, *Zoolog.* pp. 246—249. They form balls from dung, roll them very diligently, and having inclosed an egg in each, hide them underground.

*Ateuchus* WEBER, FABR., *Scarabæus* MAC L. Posterior feet elongate, with tibiæ slender, tarsi filiform; last joint of tarsi longer than rest. Head not horned, with broad margin and clypeus often both dentate. Eyes partly divided by exsert margin of head or entirely bipartite.

Sp. *Copris sacer, Scarab. sacer* L., DUMÉR. *Cons. gén. s. l. Ins.* Pl. 4, fig. 4; this species is found in southern Europe and in the north of Africa; it may with the *Ateuchus Ægyptiorum* LATR., GUÉRIN *Iconogr., Ins.* Pl. 21, fig. 1, be taken for the sacred beetle which the Egyptians figured on their monuments, and imitated in different kinds of stones as ornaments for the dead and amulets; this beetle was by others taken for an emblem of the world on account of the ball which it rolls (. . . πλάσσει σφαιροειδὲς παραπλήσιον τῷ κόσμῳ σχῆμα, HORAPOLL. *Hierogl.* I. 10).

See on this genus WESTWOOD *Descr. of new species of sacred beetles, Trans. of the Linnæan Soc.* II. pp. 155—163, Pl. 29.

Sub-genera *Gymnopleurus* ILLIG., *Sisyphus* LATR., *Circellium* LATR., *Canthon* HOFFMANNS, (*Coprobius* LATR.) and some others.

*Copris* FABR. Posterior feet with tibiæ dilated at the apex and tarsi ciliated beneath. First joint of tarsi larger than the rest. Head of males often horned (sometimes of females also).

a) *With third joint of labial palps very small, scarcely distinct.*

Sub-genera: *Eurysternus* DALM. (*Æschrotes* MAC L.), *Drepanocerus* KIRBY, *Oniticellus* ZIEGL., *Onthophagus* LATR.

Sp. *Copris nuchicornis, Scarab. nuchicornis* L.;—*Copris cœnobita* FABR., PANZER *Deutschl. Ins.* Heft 48, Tab. 6, &c.

b) *With third joint of labial palps distinct.*

Sub-genera *Onitis* FABR., *Phanœus* MAC L., *Copris* LATR., *Ontherus* ERICHS., *Pinotus* ejusd., *Canthidium* ejusd., *Macroderes* WESTW., *Scatonomus* ERICHS., *Ontocharis* DEJ., *Scatimus* ERICHS., *Cluæridium* LEPELET. et SERV., *Pedaria* LAP., *Coptorhina* HOPE.

Sp. *Copris mimas* FABR., *Scarab. Mimas* L., RŒSEL *Ins.* II. *Scar.* Cl. I. Tab. B, fig. 1, VOET *Col.* I. Tab. XXIII. fig. 4; habitat in South America, &c.

*Aphodius* ILLIG., FABR., LATR. Antennæ with nine joints. Abdomen with ventral segments free. Posterior tibiæ with two terminal spines. Eyes undivided. Scutellum distinct.

Sub-genera: *Aphodius, Oxymus* and some others proposed by MULSANT.

Sp. *Aphodius fimetarius, Scar. fimetarius* L., RŒSEL *Ins.* II. *Scar. terrestr. Præfat.* Cl. I. Tab. A. H. fig. 3, VOET *Col.* I. Tab. 21, fig. 147, PANZER *Deutschl. Ins.* Heft 31, Tab. 2;—*Aphod. subterraneus, Scar. subterraneus* L., PANZER *Deutschl. Ins.* Heft 28, Tab. 3, &c.

Compare SCHOENHERR *Syn. Insect.* I. 1, pp. 66—89, and SCHMIDT *Revision der Deutschen Aphodien-Arten*, GERMAR'S *Zeitschr. f. d. Entom.* II. s. 83—175.

*Note.*—Here are to be placed, according to ERICHSON, genera *Ægialia* LATR., and *Chiron* MAC L.; they differ however, in the labrum and mandibles being horny; wherefore they ought to be counted with the preceding section of the *Arenicolæ* as by LATREILLE. *Ægialia* is enumerated by WESTWOOD with the *Trogidæ; Chiron*, on account of a certain similarity of habit, is considered by many to be allied to the *Passali*.

Family LVII. *Xylophaga* nob. (Genera from the family of the *Xylophagi* LATR., *Ptiniores* and *Xylotrogi* ejusd.). Antennæ filiform, sometimes serrate or pectinate (at least in males), in others terminated abruptly by larger joints. Mandibles horny, short, dentate. Maxillæ bilobed. Palps filiform or thicker towards the extremity, short. Body cylindrical or oval. Head, as to the greatest part, mostly received in thorax.

*Bostrichus* GEOFFR. (*Apate* FABR.). Antennæ with ten joints, club triarticulate, perfoliate. Tarsi with joints simple, first very small, scarcely distinguishable. Thorax gibbous.

Sp. *Bostrichus capucinus, Dermestes capucinus* L., GEOFFROY *Ins.* I. Tab. 5, fig. 1, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 17, fig. 1, RATZEBURG *Forst-Ins.* I. Tab. X. fig. 14, &c.

*Psoa* FABR.

*Dysides* PERTY.

*Cis* LATR.

*Anobium* FABR. (*Ptinus* L.). Antennæ with eleven joints, the three last larger, the ninth and tenth obconical, the eleventh oval. Body oblong, anteriorly and posteriorly rotundate. Tarsi short, with five distinct joints.

Sp. *Anobium striatum* ILLIG., *Anobium pertinax* FABR., PANZER *Deutschl. Ins.* Heft 66, Tab. 5; 1½—2‴ long, black-brown with striated elytra. They live in old wood, and render our furniture wormeaten, by small round holes, from which a fine yellow powdered wood falls. The larva lives in these cylindrical passages, and resembles, like that of *Apate*, the larva of the cockchafer in miniature (see fig. of the larva of *Anob. tessellatum* in RATZEBURG *Forst-Ins.* I. Tab. II. fig. 19, of *Apate* ibid. Tab. XIV. fig. 33). This little beetle causes a ticking sound in the wood, from which vulgar superstition derives an unfavourable omen, as appears from the names *Todtenuhr, l'horloge de la mort, Death-watch.* Another smaller, red-brown species, *Anobium paniceum, Dermestes paniceus* L., PANZER *Deutschl. Ins.* Heft 66, Tab. 6, lives in biscuit, wafers, &c., and sometimes gnaws through the corks of bottles filled with white, sweet wine.

Comp. on the German species of this genus STURM *Fauna, Ins.* XI, 1837, s. 98—244. The intestinal canal of *Anob. striatum* is described and figured by LÉON DUFOUR, *Ann. des Sc. nat.* XIV, 1822, pp. 219—222, Pl. XII.

*Dryophilus* CHEVROL. With three last joints of antennæ cylindrical, very long, slender.

Sp. *Anobium pusillum* GYLLENH., *Dryoph. anobioïdes* CHEVROL, GUÉRIN *Magas. de Zool.* 1832. Cl. IX. pl. 3.

*Dorcatoma* HERBST, FABR. Antennæ with first joint thick, conical, the following to the eighth small, the three last forming the greatest part of antennæ, the ninth and tenth serrated internally, eleventh oval. Body oval, abbreviate.

Sp. *Dorcatoma Dresdense* HERBST, PANZER *Deutschl. Ins.* Heft 26, Tab. 10, &c. Comp. *Figures* in STURM l. l. Tab. 244, 245.

*Ptinus* L. (in part). Antennæ with eleven joints, filiform, long (longer than half the body), with joints sub-equal. Thorax cylindrical, constricted posteriorly. Scutellum small, distinct. Feet long, slender, with tarsi distinctly five-jointed, the first joint elongate.

Sp. *Ptinus fur* L., PANZER *Deutschl. Ins.* Heft 99, Tab. 4, ma. (*Ptinus clavipes* PANZ.), GEOFFR. *Ins.* I. Pl. II. fig. 6 fem.; 1¼—2‴ long, the antennæ of the male somewhat longer than body, the abdomen elongate, cylindrical, so that it resembles a small goat-beetle; the female with the abdomen more oval and wingless. This insect lives in old wood, in herbaria, in collections of birds and insects. GOEZE has described and figured the metamorphosis circumstantially; *Naturforscher*, VIII. 1776. s. 76—89, Tab. II. figs. 1—12.

*Gibbium* SCOPOLI. Antennæ with eleven joints, filiform, longer than half the body, with joints obconical, sub-equal, the last oval. Thorax broader posteriorly. Head small, nutant. Elytra united; wings none. Scutellum none.

*Gibbium scotias*, *Ptinus Scotias* FABR., PANZER *Deutschl. Ins.* Heft 5, Tab. 8.

Add sub-genus *Mezium* CURTIS, STURM *Fauna, Ins.* XII. pp. 34—38, Tab. 248.

*Ptilinus* GEOFFR., FABR. Antennæ with eleven joints, not longer than half the body, serrate or (in males) pectinate. Thorax posteriorly of the breadth of elytra. Wings and scutellum distinct. Feet short, with tarsi distinctly five-jointed.

Sp. *Ptilinus pectinicornis* FABR., *Ptinus pectinicornis* L., PANZER *Deutschl. Ins.* Heft 3, Tab. 7, STURM *Fauna, Ins.* XI. Tab. 236, &c. Add sub-genus *Xyletinus* LATR., comp. STURM ibid. Tab. 237.

*Lymexylon* FABR. Body elongate, narrow. Antennæ of the length of head and thorax, with eleven joints, filiform or sub-serrate. Mandibles short, thick, dentate. Maxillary palps of males with last joint ramose, flabellate. Head almost globose, nutant,

separated from thorax by a neck. Elytra shorter than abdomen, sometimes very short. Tarsi distinctly five-jointed.

Sub-genera: *Lymexylon* FABR., *Hylocœtus* LATR., *Atractocerus* PALISOT-BEAUVOIS.

Genus *Cupes* FABR. scarcely belongs here.

Family LVIII. *Serricornia* s. *Priocerata*. Antennæ mostly short or moderate, more rarely incrassated towards the apex, filiform or more slender at the apex, serrate or pectinate, especially in males. Body elongate. Elytra mostly covering abdomen entirely. Penultimate joint of tarsi often bilobed.

I. Prosternum not produced anteriorly beyond the mouth, nor mucronate posteriorly (with few exceptions). Body mostly soft, flexible (*Malacodermata* LATR., *Aprosterni* WESTW.).

*Clerus* GEOFFR. Palps, either all or at least labial, with last joint truncated, mostly broad, obtrigonal or securiform. Mandibles with apex acute, internal side emarginate or armed with another tooth. Penultimate joint of tarsi bilobed, first in many very short or indistinct. Head and thorax narrower than abdomen; head posteriorly received in thorax. Antennæ filiform or subserrate, in many clavate, with three terminal joints thicker.

Sub-genera: *Enoplium* LATR., *Necrobia* LATR., (*Corynetes* FABR.), *Laricobius* ROSENHAUER, *Clerus* GEOFFR., LATR. (*Trichodes* FABR.) *Thanasimus* LATR., *Epiclines* CHEVR., *Opilo* LATR. (*Notoxus* FABR. not GEOFFR.), *Eurypus* KIRBY, *Axina* KIRBY, *Tillus* OLIV., *Cylidrus* LATR.

Sp. *Clerus alvearius, Trichodes alvearius* FABR., PANZER *Deutschl. Ins.* Heft 31, Tab. 14, RÉAUMUR *Ins.* VI. Tab. 8, figs. 9, 10, pp. 82, 83; the red larva lives parasitically in the nests of wild bees (of the genus *Osmia*).—*Clerus violaceus, Dermestes violaceus* L., *Necrobia violacea* LATR., PANZER *Deutschl. Ins.* Heft 5, Tab. 6, DUMÉR. *Cons. gén. s. l. Ins.* Pl. 17, fig. 4, &c.

*Pelocophora* DÉJ.

*Melyris* FABR. Palps filiform, short. Mandibles emarginate or bidentate at the apex, narrow, elongate. Thorax oblongo-quadrate, little convex or plane, covering the base alone of head. Joints of tarsi entire; claws unidentate or bordered internally at the base by a membrane forming an appendage resembling a tooth. Body oblong, with dorsum plane. Antennæ filiform or serrate.

Sub-genera: *Dasytes* PAYK., FABR., *Melyris* FABR., *Zygia* FABR., *Malachius* FABR., OLIV.

Sp. *Melyris cœrulea* ILLIG., *Dasytes cœruleus* F., PANZER *Deutschl. Ins.* Heft 96, Tab. 10;—*Malachius æneus, Cantharis œnea* L., VOET *Coleopt.* I. Tab. 46, fig. 7, PANZER *Deutschl. Ins.* Heft 10, Tab. 2;—*Malach. bipustulatus* FABR., *Canthar. bipustulata* L., VOET *Col.* I. Tab. 46, fig. 6, PANZER *Deutschl. Ins.* Heft 10, Tab. 3, &c.

*Malthinus* LATR.

*Telephorus* SCHÆFF., LATR., *Cantharis* FABR., DÉJ. (Species of *Cantharides* L.). Palps securiform. Antennæ filiform, with joints elongate. Mandibles very acuté, not emarginate. Penultimate joint of tarsi bilobed; claws simple. Body oblong, soft. Head deflected, covered at the base by thorax.

Sp. *Telephorus fuscus, Cantharis fusca* L., VOET *Coleopt.* I. Tab. 46, fig. 3; —*Teleph. melanurus, Canthar. melanura* L., VOET ibid. fig. 2, PANZER *Deutschl. Ins.* Heft 85, Tab. 6, &c. On the metamorphosis of certain species cons. DE GEER *Ins.* III. Pl. 2, figs. 5—11, and BLANCHARD, GUÉRIN *Mag. de Zool.* 1836, *Ins.* Pl. 168.

*Silis* MEGERLE, DÉJ.

*Drilus* OLIV. Palps thick, conical. Mandibles bidentate. Antennæ serrate or pectinate in males (antennæ of females with ten joints obconical, subserrate). Penultimate joint of tarsi bilobed; claws simple. Females apterous, elongate, resembling larvæ, far larger than males.

Sp. *Drilus flavescens* OLIV., GEOFFR. *Ins.* I. Pl. 1, fig. 25, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 9, fig. 5, male, GUÉRIN *Iconogr., Ins.* Pl. 14, figs. 4, 5. The larva was discovered by the Count MIELZINSKY living as a parasite in *Helix nemoralis*, and the insect which proceeded from it (M. saw the female only) considered to be a new genus, and named *Cochleoctonus*. *Ann. des Sc. nat.* I. 1824, pp. 67—77, Pl. 7. DESMAREST first discovered that this animal was the female, hitherto unknown, of *Drilus flavescens; Ann. des Sc. nat.* II. pp. 257—270; comp. also, ibid. p. 443, &c., V. AUDOUIN *Rech. anatomiques sur la femelle et le mâle du Drile jaunâtre*, Pl. 15.

*Lampyris* L. Antennæ approximate at the base, filiform, with eleven joints. Eyes in males very large. Thorax plane, semiorbiculate, covering head, concealing it. Mandibles entire. Penultimate joint of tarsi bilobed; claws simple. Females mostly apterous.

Sp. *Lampyris splendidula* L., PANZER *Deutschl. Ins.* Heft 4, Tab. 8, m. and fem., SCHÆFFER, *Elem. Entom.* Tab. 74 (male), DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 9, figs. 1, 2 (*de glimworm, Johanniswurm, le ver luisant, the glow-worm*). This species, and some others (*Lampyris noctiluca* L., *Lamp. hemiptera, Lamp. italica*, &c.), diffuse a phosphoric light by night; the males shine less than the females, and with them the light ceases after the pairing; the females, on the other hand, are very luminous when laying eggs. G. R. TREVIRANUS was of opinion that the light proceeded from the internal genital organs; this subject is fully treated by him *Biologie*, V. s. 105—116, *Verm. Schriften*, I. s. 87—93. The light becomes dull in carbonic acid and hydrogen gases, and stronger in oxygen gas; see on these and other particulars a letter of MATTEUCCI to DUMAS in the *Comptes rendus*, 14 Aug. 1843.

On the different species of this genus comp. *Essai d'une revision du genre Lampyre par* DE LA PORTE *Ann. de la Soc. entomol.* II. 1833, pp. 122, 123.

*Phengodes* HOFFMANNS. Antennæ with eleven joints, bipectinate, with cirri convoluted spirally. Elytra posteriorly narrowed.

Species American, as *Lampyris plumosa* FABR. &c.

*Amydetes* HOFFMANNS.

*Omalisus* GEOFFR.

*Dictyoptera* LATR.

*Lycus* FABR., OLIV. Head small, concealed under the shield of thorax, with mouth porrect, rostrate. Palps with last joint thicker. Antennæ approximate, filiform or serrate. Elytra in many dilated, broader than abdomen.

Comp. on this genus FABRICH *Syst. Eleuth.* II. pp. 110—118, and DALMAN in SCHOENH. *Synon. Ins.* I. 3, Append. pp. 25—33, Tab. 5.

*Cyphon* FABR., (*Elodes* LATR., *Scirtes* ILLIG., LATR.). Mandibles entire, with apex simple, small, scarcely exsert beyond labrum. Palps filiform, labial furcate at the apex, with last joint inserted before the apex of penultimate. Antennæ distant, longer than thorax. Elytra rather soft. Posterior feet in many saltatory, with femora incrassated.

Sp. *Cyphon hemisphæricus* FABR., PANZER *Deutschl. Ins.* Heft 96, Tab. 7, &c.

Add genera *Eubria* ZIEGL., *Nycteus* LATR.

*Dascillus* LATR.

*Ptilodactyla* ILLIG.

Sub-genus: *Colobodera* KLUG.

Comp. KLUG *Ueber zwei neue Käfergattungen*, WIEGMANN'S *Archiv f. Naturgesch.* 1838. s. 67—70.

*Rhipicera* LATR., KIRBY.

*Sandalus* KNOCH.

*Callirhipis* LATR.

*Anelastes* KIRBY.

*Cebrio* OLIV., FABR. (in part). Mandibles entire, with apex simple, exsert, decussating. Palps filiform, labial with last joint obconical, truncated. Antennæ distant, longer than thorax (in females shorter, thick). Thorax broader posteriorly, with angles produced. Prosternum mucronate posteriorly.

Sp. *Cebrio gigas* FABR., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 8, fig. 1, PANZER *Deutschl. Ins.* Heft 5, Tab. 10; in south of Europe. The female lives under ground, and continues there at pairing time, protruding the abdomen alone, so that the male does not see her. AUDOUIN *et* BRULLÉ *Hist. nat. des Ins.* VI. 1837, pp. 221, 222.

*Physodactylus* FISCHER.

II. Prosternum produced anteriorly as far as the mouth or beyond the mouth, mucronate posteriorly. Elytra hard. (*Sternoxi* LATR., *Macrosterni* WESTW.)

*Elater* L. Antennæ setaceous, serrate or pectinate. Mandibles emarginate at the apex or bidentate. Palps with last joint larger, obtrigonal, truncated. Mucro of prosternum received in a cavity of mesosternum. Body elongate, with thorax oblong, narrower anteriorly, of the breadth of elytra posteriorly, with angles produced, acuminate. Tarsi slender.

*Spring-beetles.* When these animals are touched, they retract their feet considerably. Since the feet are very short, these beetles, when laid on their back, are not able to reach the ground, and so could not right themselves again, if they could not by throwing themselves upwards attempt to regain their feet. The animal, lying on its back, bends the thorax towards the back or downwards, and thus causes the style of the prothorax to emerge from the cavity in which it lies when at rest. Then bending the body suddenly, so that the point again shoots into the cavity, the insect with the back part of the thorax forcibly strikes the ground, and is thrown upwards by the rebound.

The larvæ live under the bark of trees, in decaying wood, or under ground, where they gnaw roots. They have an elongate cylindrical body with six feet and a very hard horny skin.

*Campylus* FISCH., *Exophthalmus* LATR. Head behind the eyes exsert from thorax. Eyes large, globose. Body elongate, almost linear.

Sp. *Campylus linearis, Elater linearis* L. (and *Elater mesomelus* ejusd.), PANZER *Deutschl. Ins.* Heft 8, Tab. 11.

*Elater* nob. Head received in thorax as far as the posterior margin of the eyes.

Sub-genera: *Ludius* LATR., *Ctenicerus* LATR., and many others proposed by ESCHSCHOLTZ and STEPHENS. Comp. WESTWOOD *Modern Classific., Generic Synopsis*, pp. 25—27, and GERMAR *Zeitschr. f. die Entom.* II. pp. 241—278, IV. pp. 43—108, V. pp. 133—192, &c.

Sp. *Elater murinus* L., VOET *Col.* I. Tab. 44, fig. 26;—*Elat. æneus* L., VOET ibid. fig. 24; *Elater aterrimus* L., PANZER *Deutschl. Ins.* Heft 101, Tab. 15, &c. The larvæ of *Elater* (*Agriotes* ESCHSCH.) *segetis, Elater lineatus* L., and other similarly thin and elongated species are sometimes extremely injurious; they gnaw the roots of grasses and corn. See on these *wireworms* KIRBY and SPENCE *Introd. to Entom.* I. pp. 180, 181, and WESTWOOD, *Modern Classif.* I. p. 238, and the authors there cited.

Amongst the numerous exotic species we note only *Elater* (*Pyrophorus* ILLIG.) *noctilucus* L., VOET *Coleopt.* I. Tab. 43, fig. 16; it has on each side of the thorax a smooth yellow spot; by night it emits a clear light, which radiates principally from the spots on the thorax (comp. TREVIRANUS *Biologie*, V. s. 100—103, 475). This, with other phosphorescent species (see KIRBY and SPENCE *Introd.* II. pp. 410—412), is found in South America. Comp. GERMAR *Zeitschr. f. Entomol.* III. 1841, s. 1—76, J. CURTIS *in Zool. Journal*, III. 1828, pp. 379—382.

[A fine specimen of *Elater noctilucus*, which had been imported in a cargo of logwood, came into VAN DER HŒVEN'S possession after it had lived some weeks in other hands. He kept it alive for a fortnight. The phosphorescent spots were, in the dark, first blue, then emerald green, then incandescent. Large printing could be read by the light, but it was necessary to carry the insect along the lines to read continuously. In oxygen gas the luminosity was not more splendid. Experiments to determine whether the temperature rose with the phosphorescence were interrupted by the death of the animal. On dissection, nothing peculiar was observed beneath the spots on the thorax, except large or smaller masses of the adipose body connected by numerous trachee. The Professor thinks it not impossible that the production of light may not be confined to a particular region, but may occur wherever the adipose body occupies the spaces between the organs in sufficient mass, and is adequately supplied with air-tubes. The two spots on the thorax, though destitute of the brown colouring matter, are of the same thickness as the neighbouring integument. Does this thickness, the Professor asks, account for the transmission of the green light, whilst that which proceeds occasionally from parts of the inferior surface, where the membrane is thin, is yellow? However this may be, the adipose body must be very unequally phosphorescent, otherwise the light from the under

surface would be always as strong as that from the upper. But it is produced only rarely, and when the animal makes much exertion. See VAN DER HŒVEN in the *Album der Natuur*, 1855, 7e Aflev. bl. 205.]

*Cerophytum* LATR.

*Throscus* LATR.

*Eucnemis* AHRENS.

Comp. *Eucnemis, insectorum genus, monographice tractatum iconibusque illustratum a Barone* DE MANNERHEIM, Petropoli, 1823. 8vo. recus. in *Ann. des Sc. natur.* III. 1824, pp. 426—434. Pl. 27.

*Galba* LATR.

*Melasis* OLIV. Last joint of palps large, globose. Antennæ of males pectinate. Tarsi slender.

*Note.*—We omit here several sub-genera, to be inserted between the genera *Elater* and *Buprestis*.

*Buprestis* L. Antennæ inserted between the anterior part of eyes, serrate, with short teeth. Mandibles short, triangular, with apex simple. Palps filiform. Head retracted within thorax nearly as far as the posterior margin of eyes. Thorax trapeziform, broader posteriorly. Scutellum small or none. Tarsi with first four joints dilated, bilobed.

Compare SOLIER *Essai sur les Buprestides, Ann. de la Soc. entom.* II. pp. 261—316.

Sp. *Buprestis gigantea* L., VOET *Coleopt.* I. Tab. 48, fig. 1, SULZER *Kennz. der Ins.* Tab. VI. fig. 38; 2″ 3‴ long; green copper-coloured; the feet steel-blue; the shield-covers terminating in two points; South America. —*Bupr. fulminans* FABR., 1″ 10‴ long, green shining, the elytra striped longitudinally with fine points, with ten fine teeth at the apex as though serrated, and a red copper-coloured spot; very common in Java. In southern Africa many species are found, which are beset with little bundles of hairs on the shield-covers, as *Buprestis fascicularis* L. In Europe, of this numerous genus[1] there are met with comparatively only few and smaller species. The larvæ live in bark and wood of trees; they have no feet, are elongate, flat and distinguished by the breadth and size of the first ring of the body next the head.

Sub-genera: *Trachys* FABR., *Aphenisticus* LATR., *Buprestis* LATR. (*Agrilus* MEGERLE and many sub-genera proposed by ESCHSCHOLTZ, SOLIER, DE LA PORTE, and GORY, &c.)

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[1] DUPONCHET announced a few years ago that he had found in different cabinets more than 1500 species of this genus,—*Dict. univ. d'Hist. nat.* II. p. 779.

Family LIX. *Brachelytra* (*Microptera* GRAVENHORST). Antennæ mostly moniliform, of the same thickness towards the apex, or thicker at the apex. Elytra much shorter than abdomen, entirely covering the wings which are long and replicate, not dehiscent. Body mostly narrow, elongate, arcuate upwards, the insect running. Dorsal segments of abdomen all horny.

Most of these insects live in offal, dung, or under decaying plants. They live on animal substances, especially other insects; so also the larvæ, which are elongate, with a large head and six strong feet. The intestinal canal of these beetles is straight and short; there are four *vasa urinaria*. The similarity of these beetles with the genus *Forficula* amongst the *Orthoptera* (see above, p. 462, 463) is rather external and does not rest upon a natural affinity in the internal structure.

The species of this family are very numerous, and in Europe far surpass even those of the *Carabici*. However, this is quite otherwise with the exotic species hitherto known, and hence some writers are of opinion that this family is eminently a form of the northern hemisphere. Perhaps this may be a hasty conclusion, and the rarity of *Staphylini* from warm countries, in our collections, may in part be attributed to the inadvertence of travelling collectors.

Compare J. L. C. GRAVENHORST *Coleoptera microptera*, Brunsvigæ, 1802, 8vo.; Ejusd. *Monographia coleopteror. micropterorum*, Gottingæ, 1806, 8vo.; MANNERHEIM in *Mém. presentés à l'Acad. des Sc. des Petersbourg*, I. 1831, pp. 415—461; G. F. ERICHSON *Genera et Species Staphylinorum, cum tab. æn. V.* Berolini, 1840, 8vo.

Section I. *Staphylinina*. Abdomen with six or seven segments distinct. Cutaneous papilla exsertile, pilose, on each side near anus in both sexes.

*Staphylinus* L. (in part), GRAVENHORST. Head entirely exsert, separated from thorax by a narrower base as by a neck. Labrum mostly bilobed. Palps mostly filiform, labial triarticulate, maxillary quadriarticulate, with last joint in the former sub-equal. Antennæ inserted in the anterior margin of frons, with eleven joints, filiform, or in some incrassated towards the apex. Tarsi with five joints.

Sub-genera. *a*) With antennæ approximate at the base: *Platyprosopus* MANNERH., *Othius* LEACH, *Holisus* ERICHSON, *Sterculia* LAPORTE, *Xantholinus* DAHL., &c.

*b*) With antennæ distant at the base: *Staphylinus* ERICHS., *Ocypus* KIRBY, *Philonthus* LEACH, *Acylophorus* NORDMANN, *Quedius* LEACH, *Astrapæus* GRAV., *Oxyporus* FABR., &c. Comp. ERICHSON, l. l. pp. 291—559.

Sp. *Staphylinus erythropterus* FABR., *Staphyl. cæsareus* CEDERHJELM, ERICHS., PANZER *Deutschl. Ins.* Heft 26, Tab. 4, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 3, fig. 1; 8‴ to 9‴ long, black, with short, yellow, glistering hairs, shield-covers and feet red-brown, antennæ yellow-brown, at the extremity mostly blackish;—*Staphyl. castanopterus* GRAV., *Staph. erythropterus* L. &c. The largest native species is *Staphylinus olens* FABR., *Ocypus olens*, PANZER l. l. Tab. 1, RATZEBURG *Forst-Ins.* I. Tab. I. fig. 14; 10‴ to 1″ long, quite black. Of this species the larva and nymph are figured by BLANCHARD in GUÉRIN *Magas. de Zool.* 1836, *Ins.* Pl. 165, and more accurately by OSW. HEER (*Observ. Entomol.* Turici, 1836, 8vo. Tab. III. A) and RATZEBURG loc. cit.

*Pæderus* FABR. Head exsert, affixed to thorax by a slender neck. Labrum with sides often membranous, bilobed, or slightly emarginate in the middle. Maxillary palps elongate, with fourth joint very small; labial palps short, triarticulate. Antennæ inserted under the margin of frons, with eleven joints, filiform. Tarsi with five joints.

*a*) Fourth joint of tarsi simple.

*Lathrobium* GRAVENH., *Stilicus* LATR., &c.

*b*) Fourth joint of tarsi bilobed or provided with a membranous lobe.

*Pæderus* GRAVENH., *Sunius* LEACH.

On these and other sub-genera compare ERICHSON l. l. pp. 560—667.

Sp. *Pæderus riparius* FABR., PANZER *Deutschl. Ins.* Heft 9, Tab. 11;—*Pæderus ruficollis* FABR., PANZER *Deutschl. Ins.* Heft 27, Tab. 23, GUÉRIN *Iconogr.* Ins. Pl. 9, fig. 5, &c.

*Procirrus* LATR.

*Pinophilus* GRAVENH.

On these and other genera and sub-genera, composing the tribe of the *Pinophilini*, consult ERICHSON l. l. pp. 668—686.

*Stenus* LATR. Head exsert, inserted in thorax by a thick neck, with eyes large, protuberant. Labrum entire, horny. Labium elongate, exsertile. Maxillary palps elongate, with fourth joint very small; labial palps short, triarticulate. Antennæ short, inserted

in the frons between the eyes, with eleven joints, last three joints incrassated. Feet slender.

A. Tarsi with five joints. Labrum entire.

Sub-genera: *Dianous* LEACH, *Stenus* LATR.

B. Tarsi with four joints. Labrum denticulate or serrate.

*Euaesthetus* GRAVENH.

Sp. *Stenus biguttatus, Staphylinus biguttatus* L., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 3, fig. 4, PANZER *Deutschl. Ins.* Heft 11, Tab. 17, &c.

Compare THION, *Description des organes de la manducation chez les Stènes, Ann. de la Soc. Entom.* IV. 1835, pp. 153—168, Pl. 3 B.

*Oxytelus* GRAVENH. Head exsert, with base narrower. Labrum entire, horny, mostly enlarged at the apex on both sides by a membranous lacinia. Maxillary palps much shorter than head, with fourth joint distinct, often subulate. Anterior tibiæ mostly spinose. Head in many horned. Tarsi with last joint very long.

A. Tarsi with five joints.

*Megalops* DÉJ. Antennæ with ten joints, clavate.

*Osorius* LEACH. Antennæ with eleven joints, filiform.

B. Tarsi with three joints. Antennæ with eleven joints.

Sub-genera: *Oxytelus* GRAV. (in part), *Bledius* LEACH, *Platysthetus* MANNERH., *Coprophilus* LATR. and some others.

Compare LATREILLE *Considérations sur la tribu des Denticrures, Nouv. Ann. du Muséum*, I. 1832, pp. 77—92; ERICHSON l. l. pp. 759—822.

Sp. *Oxytelus tricornis* GRAVENH., PANZER *Deutschl. Ins.* Heft 66, Tab. 17;—*Oxytel. piceus, Staph. piceus* L., PANZER *Deutschl. Ins.* Heft 27, Tab. 12; *Oxytelus (Coprophilus) rugosus*, GUÉRIN *Iconogr. Ins.* Pl. X. fig. 2, GERMAR *Faun. Ins. Europ.* Fasc. XV. Tab. 2, &c.

*Piestus* GRAVENH.

*Prognatha* LATR. (*Siagonium* KIRBY), *Leptochirus* GERMAR, &c.

Compare ERICHSON l. l. pp. 823—841.

*Omalium* GRAVENH. Head porrect, scarcely constricted at the base. Labrum transverse, horny, simple or supplied with a membranous border at the apex. Antennæ with eleven joints, straight, filiform. Elytra mostly longer than pectus, sometimes covering a large part of abdomen. Tarsi with five joints. Body depressed.

A. Ocelli none.

Sub-genera: *Olisthærus* DÉJ., *Phlœocharis* MANNERH.

B. Ocelli two.

Sub-genera: *Anthophagus* GRAV., *Lesteva* LATR., *Omalium* GRAVENH. (in part), *Anthobium* LEACH, and some others proposed by ERICHSON and others. Comp. ERICHSON, l. l. pp. 846—900.

Sp. *Omalium rivulare* GRAVENH., PANZER *Deutschl. Ins.* Heft 27, Tab. 15; —*Omalium fossulatum* ERICHS., *Omal. cæsum* GYLL. &c.

*Proteinus* LATR. Head porrect, received posteriorly in thorax. Antennæ clavate or incrassated at the apex, mostly with eleven joints, sometimes with nine. Maxillary palps with fourth joint narrower, acuminate. Ocelli none, or ocellus single, frontal. Body depressed; elytra longish. Tarsi mostly with five joints, in a few with three joints.

Sub-genera: *Proteinus* LATR. (in part), *Megarthrus* KIRBY, *Phlœobium* DÉJEAN, *Glyptoma* ERICHS., *Micropeplus* LATR.

Sp. *Proteinus brachypterus, Dermestes brachypterus* FABR., CUVIER *R. Ani., éd. ill., Ins.* Pl. 21, fig. 8; *Megarthrus depressus* ERICHS. &c.

*Aleochara* GRAVENH. Head small, exsert, often deflected. Labrum entire, horny. Maxillary palps with fourth joint subulate. Antennæ with eleven or ten joints, inserted in frons at the internal margin of eyes, incrassated gradually at the apex, or clavate. Feet slender, with tibiæ mostly unarmed, tarsi with five joints, sometimes with four, either the anterior only or all.

Sub-genera: *Myrmedonia* ERICHS., *Aleochara* GRAVENH. (in part), *Bolitochara* MANNERH., *Oxypoda* MANNERH., *Oligota* MANNERH., *Lomechusa* GRAVENH., *Gyrophæna* MANNERH., *Myllæna* ERICHS., *Gymnusa* KARSTEN, &c. Cons. ERICHSON, l. l., pp. 33—212.

Sp. *Aleochara canaliculata* GRAV., *Staphyl. canaliculatus* FABR., PANZER *Deutschl. Ins.* Heft 27, Tab. 10, GUÉRIN *Iconogr., Ins.* Pl. 10, fig. 5;—*Aleoch. fuscipes* GRAV., GERMAR *Faun. Ins. Europ.* Fasc. XIII. Tab. 8, &c.

*Tachyporus* GRAVENH. Head intruded posteriorly into thorax almost as far as the eyes, not narrower at the base. Labrum entire, simple. Antennæ below the eyes, inserted under the lateral margin of head, mostly filiform, with eleven joints, in a few clavate, with ten

joints. Feet with tibiæ mostly spinose, tarsi with five joints, more rarely with four. Body convex, oval.

Sub-genera: *Hypocyptus* SCHUEPP., *Tachyporus* GRAVEN., *Tachinus* GRAVENH., *Boletobius* LEACH, &c. Comp. ERICHSON, pp. 213—289.

Sp. *Tachyporus analis* GRAV., *Staphyl. obtusus* L., PANZER *Deutschl. Ins.* Heft 22, Tab. 16;—*Tachyporus marginatus* GRAV., *Staphyl. hypnorum* FABR., PANZER *Deutschl. Ins.* Heft 27, Tab. 17, GUÉRIN *Iconogr., Ins.* Pl. 10, fig. 9, &c.

Section II. *Pselaphina.* Abdomen with five segments, rotundate, obtuse. Antennæ clavate. Tarsi triarticulate.

Compare C. AUBÉ *Pselaphiorum Monographia*, GUÉRIN, *Magasin de Zool.* 1833, *Ins.* Pl. 78—94; H. H. SCHMIDT *Diss. inaug. zool. de Pselaphis Faunæ Pragensis cum anatomia Clavigeri.* Pragæ, 1836. 8vo.

They are small insects that live under stones, bark of trees, decaying leaves, and in ants' nests.

A. *Antennæ with joints indistinct, or with single joint, thick, truncated.*

*Articerus* DALM.

B. *Antennæ with six joints.*

*Claviger* PREYSSLER. Eyes none (ocelli two SCHMIDT). Claw of tarsi simple.

Sp. *Claviger testaceus* PANZER *Deutschl. Ins.* Heft 9, Tab. 3, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 22, fig. 5. Compare P. W. J. MUELLER *Beiträge zur Naturgesch. der Gattung Claviger*, GERMAR'S *Magazin der Entomol.* III. 1818, pp. 69—112.

C. *Antennæ with eleven joints.*

*Pselaphus* HERBST. Maxillary palps mostly elongate, clavate. Eyes two.

Sub-genera. *a*) With single claw of tarsi: *Pselaphus*, HERBST (in part), *Bryaxis* LEACH, *Bythinus*, *Tychus* ejusd., *Euplectus* ejusd. —*b*) With two claws of tarsi: *Chennium* LATR., *Tyrus* AUBÉ, *Batrisus* AUBÉ; whom see l. l. Comp. also ERICHSON, *Die Käfer der Mark Brandenburg*, I. pp. 263—281.

Sp. *Chennium bituberculatum*, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 23, fig. 4, &c.

Family LX. *Clavicornia* (*Clavicornes* LATR., *Histeridæ*, *Byrrhidæ*, *Dermestidæ*, *Silphidæ*, &c. LEACH). Antennæ mostly with eleven joints, terminated by a club perfoliate or solid, or gradually

incrassated towards the extremity, longer than maxillary palps, with base little covered or quite naked. Integuments hard. Elytra sometimes abbreviate, in all however covering the greatest part of abdomen. Joints of tarsi mostly entire.

*Scydmœnus* LATR. Maxillary palps elongate, with fourth joint subulate, small or very small, scarcely distinguishable. Antennæ moniliform, gradually incrassated towards the apex, or clavate. Elytra mostly solute. Head exsert, mostly constricted posteriorly.

Sp. *Scydmœnus Hellwigii* LATR., *Notoxus minutus* PANZER *Deutschl. Ins.* Heft 23, Tab. 6; *Scydm. Godarti* LATR. *Gener. Crust. et Ins.* Tab. VIII. fig. 6, &c. Several species are described and figured by STURM *Deutschl. Fauna, Ins.* XIII. pp. 1—51, Tab. 259—264.

*Clidius* LAPORTE.

*Mastigus* ILLIG. Antennæ filiform, scarcely incrassated at the apex, with first joint very long. Maxillary palps elongate, clavate. Elytra connate, wings none. Head exsert, constricted posteriorly.

Sp. *Mastigus palpalis* LATR. l. l. fig. 5, CUV. *R. Ani., 6d ill., Ins.* Pl. 34, fig. 10. For other species see KLUG *Entomolog. Monogr.* pp. 161—168.

*Hister* L. Antennæ short, geniculate, with first joint elongate, clavate, with capitulum oval or subglobose, solid, triarticulate. Mandibles arcuate at the apex, denticulate, mostly exsert. Maxillæ with two membranous lobes. Palps filiform. Head small, mostly retractile within thorax. Feet contractile, anterior approximate at the base, posterior remote at the insertion, with tarsi all five-jointed. Elytra shorter than abdomen, truncated. Body smooth, mostly subquadrate. Abdomen composed of five segments.

*a*) With head not retractile.

*Hololepta* PAYK.

*b*) With head retractile.

Sub-genera: *Saprinus* ERICHS., *Abræus* LEACH, *Onthophilus* LEACH, *Hister* LEACH, *Platysoma* LEACH, &c.

Sp. *Hister unicolor* L., STURM *Deutschl. Ins.* I. Tab. 16;—*Hister maculatus* L., &c.

*Necrophorus* FABR. Antennæ short, clavate, with capitulum subglobose. Maxillæ unarmed. Palps short, filiform. Ligula

bifid, with laciniæ divergent, internally ciliated. Elytra shorter than abdomen, truncated. Anterior tarsi broad, furnished with fasciculi of hairs.

Sp. *Necrophorus vespillo* FABR., *Silpha vespillo* L., RŒSEL *Ins.* IV. Tab. 1, PANZER *Deutschl. Ins.* Heft 2, Tab. 21; *the grave-digger*; 6‴—8‴ long, black, elytra with two orange-coloured transverse bands, the club of antennæ brown. This beetle flies with elytra erect, the under-side turned outwards; it diffuses a strong smell resembling musk. Like *Geotrupes stercorarius* and *vernalis* it is sometimes infested by small acari. The periods of larva and nymph together extend only to seven weeks. This species, like the others of this genus, feeds on dead animal substances. By an union of their forces these beetles dig away the ground from under the carcases of small animals, moles, mice, &c. and so bury them beneath it. They lay their eggs in the bodies thus interred, and the larvæ feed on them. —*Necrophorus humator* FABR., PANZER *Deutschl. Ins.* Heft 41, Tab. 2, &c.

*Silpha* L. (exclusive of some species, FABR.) Antennæ longer than head, with club elongate or gradually thicker towards the apex. Maxillæ armed internally with a horny hook. Head small. Thorax broad, plane, marginate.

Sub-genera: *Necrodes* WILKIN, *Oiceoptoma* LEACH, *Thanatophilus* LEACH, *Phosphaga* LEACH.

Sp. *Silpha littoralis* L. (*Necrodes*), SULZER *Gesch. d. Ins.* Tab. II. fig. 14, (*Silpha clavipes*), PANZER *Deutschl. Ins.* Heft 40, Tab. 15;—*Silpha quadripunctata* L., VOET *Coleopt.* 1. Tab. 41, fig. 5, PANZER *Deutschl. Ins.* Heft 40, Tab. 18. This beetle hunts after different kinds of caterpillars on oaks and other trees.

*Necrophilus* LATR. Maxillæ unarmed, with two membranous laciniæ. Palps very short, thickish. Thorax broad, exsert anteriorly.

Sp. *Silpha subterranea* ILLIG., STURM *Deutschl. Fauna, Ins.* XIII. Tab. 270.

*Agyrtes* FROELICH.

Consult FROELICH *Naturforscher*, XXVIII. 1799, s. 15—19, Tab. 1, fig. 11.

*Catops* FABR.

*Choleva* LATR., SPENCE.

Consult Monography of this genus by SPENCE in *Transact. of the Linn. Soc.* XI. 1815, p. 123—160.

Sp. *Catops chrysomeloïdes*, *Helops chrysomeloïdes*, PANZER *Deutschl. Ins.* Heft 57, Tab. 1, &c., STURM *Deutschl. Fauna, Ins.* XIV. Tab. 275, fig. b, B.

*Colon* HERBST.

Consult STURM *Deutschl. Fauna, Ins.* XIV. pp. 46—74.

*Scaphidium* OLIV. Antennæ straight, moderate, thicker at the apex, mostly provided with a club of five joints. Mandibles small, horny, with border membranous internally, unidentate or bidentate. Maxillæ with two membranous laciniæ. Maxillary palps quadriarticulate, with last joint acuminate at the apex. Labial palps very short. Body navicular, at both ends angustato-acuminate, with head small, deflected. Elytra truncated at the apex. Feet slender.

Sub-genera: *Scaphidium* LEACH, *Scaphium* KIRBY, *Amalocera* ERICHSON, *Scaphisoma* LEACH.

Sp. *Scaphidium agaricinum, Silpha agaricina* L., PANZER *Deutschl. Ins.* Heft 2, Tab. 3, &c.

*Nitidula* FABR. Antennæ straight, clavate, club mostly triarticulate. Labrum distinct. Mandibles partly exsert, emarginate or bidentate at the apex. Maxillæ mostly with single membranous lacinia, the external lacinia obsolete. Palps short, filiform. Head retracted within thorax almost as far as the eyes. Elytra often abbreviate. Tarsi with fourth joint very small, subindistinct.

*Cercus* LATR., *Brachypterus* KUGEL., *Carpophilus* LEACH, *Nitidula* LATR., (*Ipidia, Epurœa, Nitidula, Soronia, Amphotis, Omosita* ERICHS., *Pria* KIRBY, *Meligethes* KIRBY), *Thalicra* ERICHS., *Pocadius* ERICHS., *Cychramus* KUGEL. (*Strongylus* HERBST), *Cybocephalus* ERICHS., *Cyllodes* ejusd.

Compare ERICHSON, GERMAR'S *Zeitsch. f. d. Entom.* IV. 1843, p. 225, &c. V. 1844, p. 438 &c.; ERICHSON'S *Naturgesch. d. Ins. Deutschl.* III. pp. 125—220.

Sp. *Nitidula bipustulata* FABR., *Silpha bipustulata* L., PANZER, *Deutschl. Ins.* Heft 3, Tab. 10, STURM *Deutschl. Fauna, Ins.* XV. Tab. 298, &c.

*Ips.* FABR. Labrum membranous, concealed under the clypeus, perrect between the mandibles. Maxillæ with single lacinia. Tarsi as in the preceding genus.

*Rhizophagus* HERBST.

*Peltis* GEOFFR., *Thymalus* LATR. Antennæ with club triarticulate. Maxillæ with two laciniæ, the interior armed with a horny hook. Body broad, depressed, with thorax and elytra marginate.

*Trogosita* OLIV., FABR., LATR. Antennæ with eleven joints, moniliform, subclavate. Mandibles exsert, porrect, with apex bidentate. Internal lacinia of maxillæ obsolete. Palps filiform, incrassated at the apex. First joint of tarsi small. Body elongate, depressed.

Sp. *Trogosita mauritanica, Tenebrio mauritanicus* L., PANZER *Deutschl. Ins.* Heft 3, Tab. 4, STURM *Deutschl. Fauna, Ins.* II. Tab. 48.

*Temnochila* ERICHS.

*Nemosoma* LATR.

*Colydium* FABR. Antennæ short, with club triarticulate. Maxillary palps with last joint larger, subsecuriform. Tarsi quadriarticulate. Body elongate, cylindrical.

*Note.*—Here also ought to be placed, according to ERICHSON, genera *Sarrotrium* and *Corticus* classed with the *Tenebriones* (see above p. 496), and *Coxelus*, placed amongst the *Diaperiales*, p. 494.

*Rhysodes* ILLIG.

Consult GERMAR *Faun. Ins. Europ.* Fasc. VI. Tab. 1, where the characters are set forth.

*Passandra* DALM.

*Prostomis* LATR.

Sp. *Trogosita mandibularis* FABR., STURM *Deutschl. Fauna, Ins.* II. Tab. 49, PANZER *Deutschl. Ins.* Heft 105, Tab. 3.

*Cucujus* FABR. Antennæ filiform. Labrum small. Mandibles exsert. Maxillæ bilobed, with internal lacinia small, acuminate. Palps short, filiform. Feet short, with first joint of tarsi mostly very small. (Posterior tarsi in males with four joints.) Body elongate, depressed.

*Uleiota* LATR. (*Brontes* FABR. in part). Antennæ of the length of body, or longer than body.

Sp. *Cucujus flaviceps* FABR., *Cerambyx planatus* L., PANZER *Deutschl. Ins.* Heft 95, Tab. 4, DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 17, fig. 7, &c.

*Cryptophagus* HERBST (*Dacne* LATR. in part). Antennæ with eleven joints, clavate. Mandibles short, strong. Maxillæ bilobed. Palps short, incrassated towards the extremity. All the tarsi in both sexes pentamerous, or posterior in males tetramerous.

*Anterophagus* KNOCH, *Emphylus* ERICHS., *Paramecosoma* CURTIS, *Atomaria* KIRBY, *Epistemus* WESTW., ERICHS.

Sp. *Cryptophagus crenatus* HERBST, *Dermestes cellaris* SCOPOLI, STURM *Deutschl. Ins.* XVI. Tab. 313, fig. D.

*Silvanus* LATR.

*Mycetophagus* FABR., OLIV. Antennæ gradually thicker towards the apex or clavate. Labrum distinct, horny, covering mandibles. Mandibles with apex bidentate. Palps filiform, labial short, maxillary longer, incrassate. Tarsi quadriarticulate, anterior of male triarticulate.

Sp. *Mycetophagus piceus* FABR., *Mycetoph. variabilis* GYLL., PANZER *Deutschl. Ins.* Heft 1, Tab. 22, &c.

Add genera *Triphyllus* MEG., *Typhœa* KIRBY, and some others here omitted.

*Ptilium* SCHUEPPEL, *Trichopteryx* KIRBY. Antennæ straight, with eleven joints, the three terminal joints incrassated. Tarsi triarticulate; seta, furnished with terminal pulvillus, placed between the claws. Wings narrow, lanceolate, ciliated at the margin.

Sp. *Ptilium fasciculare, Trichopt. grandicollis* ERICHS., STURM *Deutschl. Ins.* XVII. Tab. 322, fig. 1, &c.

Small insects (scarcely more than $\frac{1}{3}$''' long), living in ant-hills under decaying leaves, the bark of trees, &c. with elytra often abbreviate, truncated. Compare GILLMEISTER, STURM *Deutschl. Ins.* XVII. 1845, ERICHSON *Naturgesch. d. Ins. Deutschl.* III. pp. 13—40.

*Dermestes* L. Antennæ frontal, straight, short, clavate, with club mostly triarticulate. Mandibles short; maxillæ with two laciniæ, mostly membranous. Palps short, incrassated. Tarsi with five joints. Abdomen with five ventral segments, free. Feet contractile under the body. Elytra entirely covering abdomen.

Sp. *Dermestes lardarius* L., BLANKAART *Schouburg*, Tab. XI. p. 96, figs. K, L, M, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 6, fig. 10; 3''' long, black, with a grey, transverse band at the base of the shield-covers; very common in houses. *Derm. murinus* L., PANZER *Deutschl. Ins.* Heft 40, Tab. 10, &c. These insects in the larval and perfect states feed on all kinds of animal substances: leather, bacon, &c.

*Note.*—The remaining sub-genera, composing the tribe of the *Dermestini*, are furnished with a single frontal ocellus, which is absent in *Dermestes*.

*Attagenus* LATR. (*Megatoma* ejusd.), *Megatoma* HERBST, *Trogoderma* LATR., *Tiresias* STEPH., *Anthrenus* GEOFFR. (*Byrrhus* L. exclusive of species), *Trinodes* MEG.

Sp. *Anthrenus museorum, Dermestes* (and *Byrrhus*) *museorum* L., PANZER *Deutschl. Ins.* Heft 100, Tab. 2, STURM *Deutschl. Ins.* II. Tab. 37. The larva is hairy; particularly there are bundles of long hairs at the posterior extremity, with dart-shaped points very elegant under the microscope.

*Byrrhus* auct. (species of *Byrrhus* L). Antennæ incrassated towards the apex, or clavate, with club distinctly articulate. Mandibles denticulate. Maxillæ with two laciniæ. Palps incrassated at the apex, truncated. Head small, received in thorax. Feet contractile, with tarsi replicate towards the tibiæ, and tibiæ upon the femora. Tarsi with five joints. Body gibbous.

Sp. *Byrrhus pilula* L., PANZER *Deutschl. Ins.* Heft 4, Tab. 3, STURM *Deutschl. Ins.* II. Tab. 33, &c.

*Cytilus* ERICHS. Palps with last joint acuminate. Antennæ clavate.

Sp. *Byrrhus varius* FABR., PANZER *Deutschl. Ins.* Heft 32, Tab. 3.

*Limnichus* ZIEGL.

*Nosodendron* LATR.

*Agathidium* ILLIG. Antennæ with eleven joints, clavate. Mandibles strong, arcuate. Maxillæ with two lobes. Palps filiform. Head nutant. Abdomen with six ventral segments. Elytra entirely covering abdomen. Feet somewhat slender, with tarsi of posterior feet in males, sometimes also of middle or of all the feet in females, quadriarticulate. Body contractile into a ball.

Compare on this genus and its division ERICHSON *Naturgesch. d. Ins. Deutschl.* III. pp. 87—134, STURM *Deutschl. Ins.* II. s. 53, &c. Small coleoptera living in fungi and decaying trees.

*Anisotoma* KNOCH, ILLIG.

*Note.*—A genus much resembling the preceding, but with body not contractile into a ball. Feet stronger, with tibiæ spinose. All the tarsi in some five-jointed, in others the posterior or middle four-jointed, or anterior four-jointed, middle and posterior three-jointed, the number however not differing with the sex. ERICHSON l. l. p. 44, whom see on the division of this genus.

*Pausus* L. Antennæ large, very broad, with somewhat few joints, sometimes only with two or three, the last very large.

Palps large, exsert. Elytra truncated. Tarsi short, with first joint minute. Body oblong, depressed. Abdomen broader than thorax.

Small coleoptera, with almost the habit of *Hispa* or *Alurnus*, exotic, often met with, as it seems, in ants' nests. LINNÆUS first founded the genus in A. DAHL *Bigis Insectorum* 1775, *Amoenit. Academ.* VIII. p. 307. Compare AFZELIUS *Transact. of the Linn. Soc.* Vol. IV. p. 243, &c. and WESTWOOD ibid. Vol. XVI. pp. 607—684, Pl. 33, and his *Arcan. Entom.* II. pp. 1—12, 37—40, 73—80, 261—190.

A. Head supplied posteriorly with a neck.

*Cerapterus* SWED. Antennæ with ten joints, club with nine joints.

Compare N. S. SWEDERUS in *Vetensk. Akad. nya Handb.* 1788, p. 203.

*Pentaplatarthrus* WESTW. Antennæ with seven or six joints, club elongate, broad, with five joints.

*Paussus* L. Antennæ with two or three joints, club broad, exarticulate.

Sp. *Paussus microcephalus* L., *Amoen. Acad.* VIII. Tab. VI. figs. 6—10; —*Paussus thoracicus* DONOV., *Pauss. trigonicornis* LATR., *Gen. crust. et Ins.* I. Tab. XI. fig. 8, &c.

B. Head immersed in thorax.

*Hylotorus* DALM. Antennæ with two or three joints, club exarticulate, lanceolate, incurved, acuminate. Head furnished with two conical tubercles (ocelli?).

Sp. *Hylotor. bucephalus* GYLLENH. in SCHOENH. *Syn. Ins.* I. 3, *App.* Tab. VI. fig. 2.

*Heterocerus* BOSC. Antennæ inserted under the lateral margin of frons, with eleven joints, first two large, broad, two following small, rest transverse, dilated, forming an elongated club. Head received within thorax almost to the eyes. Mandibles porrect, denticulate. Palps filiform. Body oblong, depressed, pubescent. Tibiæ, especially anterior, spinose. Tarsi quadriarticulate.

Sp. *Heterocerus marginatus* FABR., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 7, fig. 7, PANZER *Deutschl. Ins.* Heft 23, Tab. 12, &c. Small insects, the largest species of which is scarcely more than 2‴ long, and which in all their states live in passages near the edge of the water. On the internal structure compare LÉON DUFOUR *Ann. des Sc. natur.* 2e Série I. *Zoolog.* p. 60 and following, with figures.

*Dryops* OLIV., *Parnus* FABR. Antennæ frontal, very short, with ten or eleven joints, auriculate, with second joint large, covering the rest. Mandibles not exsert. Maxillæ with two laciniæ, the internal not broader than the external. Tarsi with five joints, the last joint and claws strong. Body pubescent and pilose.

*Helichus* ERICHSON, *Dryops* LEACH, *Parygrus* ERICHS., *Parnus* FABR., ERICHS.

Sp. *Dryops auriculatus* OLIV., LATR., *Parnus prolifericornis* FABR., PANZER *Deutschl. Ins.* Heft 13, Tab. 1, CUV. *R. Ani., éd. ill., Ins.* Pl. 37, fig. 5; $2\frac{1}{2}'''$ long, black-brown, feet brown, covered with a silky glistering felt: this insect lives at the bottom of fresh water, amongst the roots of water-plants.

*Potamophilus* GERMAR, *Hydera* LATR.

*Elmis* LATR. Antennæ mostly with eleven joints, filiform or scarcely incrassated towards the apex. Maxillæ with two horny laciniæ, the external narrow, palpiform. Feet elongate, tarsi with five joints.

Sub-genera: *Limnius* MUELL., ERICHS., *Stenelmis* LÉON DUFOUR, &c.

*Macronychus* MUELL., LATR. Antennæ sexarticulate, with last joint oval, forming capitulum.

Sp. *Macron. quadrituberculatus*, GERMAR *Faun. Ins. Eur.* X. Tab. 4, GUÉRIN *Icon., Ins.* Pl. 20, fig. 4.

*Georissus* LATR. Antennæ short, with nine joints, clavate, with club globose, triarticulate. Head nutant. Body globose, apterous. Elytra connate. Tarsi with four joints.

Fig. PANZER *Deutschl. Ins.* Heft 62, Tab. 5, GERMAR *Faun. Ins. Eur.* Fasc. 15, Tab. 3, GUÉRIN *Icon., Ins.* Pl. 20, fig. 5 &c. Small insects, scarcely $\frac{4}{5}'''$ long, living on the banks of rivers and streams.

Family LXI. *Palpicornia.* Antennæ short, with six to nine joints, inserted in a deep sinus under the lateral margin of head, terminated by a club perfoliate or solid. Palps filiform, unequal, labial shorter, maxillary nearly of the length of antennæ or sometimes longer than antennæ. Body gibbous, mostly hemispherical or oval. Mentum large, clypeiform.

*Sphæridium* FABR. Maxillary palps nearly of the length of antennæ, with four joints, the first small, the second incrassated, obconical. Maxillæ with two laciniæ membranous or coriaceous.

First joint of tarsi equalling or surpassing the second in length. Antennæ with nine or eight joints, the first elongate, the last three incrassated, forming a club. Body ovate or orbicular.

Sub-genera: *Cercyon* LEACH (*Cercyon* and *Trichopoda* BRULLÉ), *Sphæridium* FABR. (in part), *Cyclonotum* DÉJ. (*Cœlostoma* BRULLÉ).

Sp. *Sphæridium scarabæoïdes* FABR., *Dermestes scarabæoïdes* L., VOET *Coleopt.* I, Tab. 32, fig. 1, PANZER *Deutschl. Ins.* Heft 6, Tab. 2, STURM *Deutschl. Faun., Ins.* Tab. XXI. &c. These insects live on the land in dung. Other species live under wet moss, or in muddy ground.

*Hydrophilus* GEOFFR., FABR. Maxillary palps with second joint not incrassated. Maxillæ with two coriaceous laciniæ. First joint of tarsi very short, connate with the second. Antennæ with eight or nine joints. Body ovate. Thorax broader posteriorly.

A. *With antennæ of nine joints.*

1. *With sternum carinate.*

*Hydrophilus* FABR. (in part), *Hydrophilus* and *Hydrobius* LEACH.

Sp. *Hydrophilus piceus* FABR., *Dytiscus piceus* L., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 6, fig. 9, PANZER *Deutschl. Ins.* Heft 110, Tab. 12; the largest species of this genus 1½ to 1¾ inches long, pitch-black, shining, the antennæ and feelers red-brown; the thorax terminating in a sharp point between the hind-feet. This beetle lives in fresh water, and feeds especially as perfect insect, yet also as larva, on water-slugs, and swims very quickly. The abdomen is covered beneath with a stratum of air, as though with silver. This air (a provision for respiration) is renewed by the beetle, by means of air-bubbles taken up on his antennæ, which he brings from time to time to the surface of the water (NITZSCH in REIL'S *Archiv f. d. Physiol.* X. p. 440). The female spins for her eggs an oblong, pod-shaped nest of a yellow-brown colour, terminating above in a little curved horn, which floats on the water amongst the duckweed. In this the eggs lie in regular order. The young larvæ, some time after they have come forth perforate this web, and cast themselves into the water. See LYONET in his translation of LESSER, *Théologie des Ins.* I. p. 159, fig. XVI. and *Ouvrage posthume*, pp. 133—151, Pl. 13; compare also MIGER, *Ann. du Mus. d'Hist. nat.* XIV. pp. 441—459, Pl. 28.—*Hydrophilus scarabæoïdes* FABR., (*Hydrobius*) PANZER *Deutschl. Ins.* Heft 67, Tab. 12, &c.

2. *With sternum simple.*

*Cyllidium* ERICHSON.

B. *With antennæ of eight joints.*

*Berosus, Laccobius, Limnebius* LEACH.

*Helophorus* ILLIG. (*Elophorus* FABR.). Maxillæ with two coriaceous laciniæ. Maxillary palps with second joint not incrassated.

First joint of tarsi very short, strictly connate with second, last elongate. Antennæ with seven to nine joints. Body oblong. Thorax narrowed towards the base.

Sub-genera: *Hydræna* KUG., *Ochthebius* LEACH, *Hydrochus* GERMAR, *Helophorus* ILLIG.

Sp. *Heloph. grandis* ILLIG., *Eloph. aquaticus* FABR., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 6, fig. 8, STURM *Deutschl. Faun., Ins.* X. Tab. 219, fig. A &c.

*Spercheus* FABR. Maxilla with external lacinia horny, palpiform, acuminate, incurved, ciliated internally, with internal lacinia coriaceous, pilose at the apex. First joint of tarsi not less than second, last elongate, equalling the first four in length. Antennæ short, thick, sex-articulate.

Sp. *Spercheus emarginatus* FABR., PANZER *Deutschl. Ins.* Heft 91, Tab. 4, STURM l. l. IX. Tab. 214, CUV. *R. Ani. éd. ill., Ins.* Pl. 38, fig. 4; 3‴ long, dull brown, very convex on the back; head-shield excised in front: this little beetle creeps upon the roots of water-plants.

This genus forms the transition to the following family, and from the form of the under-jaws belongs to the neighbourhood of *Gyrinus*.

Family LXII. *Hydrocantharina* or *Dytiscina*. Maxillæ horny, with external lacinia palpiform, articulate. Mandibles, as to the greatest part, covered. Four posterior feet natatory, two posterior remote from the rest. Body oval, thorax broad, transverse.

A. *Abdomen composed of six segments.*

*Gyrinus* GEOFFR., L. Antennæ shorter than head, fusiform, with nine joints, auriculate at the base. Eyes divided by the lateral margin of head into two parts quite separate. Anterior feet long, porrect; four posterior feet short, broad. Elytra posteriorly rotundate, not covering the apex of abdomen.

Sub-genera: *Orectochilus* ESCHSCH., *Cybister* ESCHSCH. (*Gyretes* BRULLÉ), *Dineutes* MAC L. (*Cyclous* ESCHSCH., DÉJ.), *Gyrinus*, *Enhydrus* LAPORTE. Comp. AUDOUIN et BRULLÉ *Hist. nat. des Ins.* V. pp. 234—242.

Sp. *Gyrinus natator* L., RÖSEL *Ins.* III. Tab. XXXI., PANZER *Deutschl. Ins.* Heft 3, Tab. 5, AHRENS et GERMAR *Faun. Ins. Europ.* II. Tab. 5; the male 2‴, the female 3‴ long, blue-black, shining; the shields are stippled in longitudinal rows. These *whirling beetles* make their appearance early in spring in fresh water, revolving in circles on the surface of the water with much rapidity. On the least alarm they dive suddenly below. Several other European species are figured in AHRENS and GERMAR *Faun. Ins. Eur.* Tab. II.

In *Orectochilus* (*Gyrinus villosus* FABR., STURM *Deutschl. Ins.* X. Tab. 227) the outermost palpiform lobe of the under-jaws is wanting, and thus they have only one feeler. So also in many large exotic species. Hence this character of the family is not constant, but the agreement of *habitus* does not permit these species to be placed elsewhere.

B. *Abdomen composed of seven segments, the first three connate.*

*Dytiscus* L. (exclusive of the *Hydrophili*, *Dytiscus* GEOFFR.). Antennæ longer than head, filiform or setaceous, with eleven joints. Eyes marginal. Head retracted within thorax as far as the posterior margin of eyes. Posterior coxæ ample. Maxillæ arcuate, acuminate; external maxillary palps with last joint oval, larger, thicker or truncated.

Compare G. F. ERICHSON *Genera Dyticeorum* Berolini, 1832; ejusd. *Die Käfer der Mark Brandenburg*, I. p. 140, &c.

A. All the tarsi with five joints, anterior of males patellate.

*Dytiscus* CLAIRV., nob. (Sub-genera: *Cybister* CURTIS, *Acilius* LEACH, *Hydaticus* LEACH, *Dytiscus* LEACH, ERICHS.)

Sp. *Dytiscus marginalis* L., RÖSEL *Ins.* II. *Ins. Aquat.* Cl. I. Tab. I, LYONET *Ouvr. posth.* Pl. XI. figs. 1—8, STURM *Deutschl. Fauna, Ins.* VIII. Tab. 185, 186, DÉJEAN et AUBÉ, *Iconogr. et Hist. nat. des Coleopt. d'Europe*, Tom. V. Pl. 5, figs. 3, 4; 15‴ long, feet and body red-brown, thorax and shield-covers gleaming black, a yellow-brown border along all the sides of the thorax and along the outer edge of shield-covers; the female (*Dytiscus semistriatus* L.) has longitudinal furrows on the shield-covers more than half their length. The females also of other species are distinguished by similarly striated elytra, although in some of these females with smooth shield-covers occur. The first three joints of the tarsi of the fore-feet form in the male a round disc which is haired on the margin, and supplied with suckers below.—*Dytiscus* (*Acilius*) *sulcatus* L., PANZER *Deutschl. Ins.* Heft 31, Tab. 9, 10, STURM l. l. Tab. 189, &c.

The larvæ of these water-beetles have a large oval head, armed with strong curved jaws, three pairs of thin haired feet, and two appendages at the hind part of the body subservient to respiration. They are very voracious, and like the larvæ of libellæ are incessantly on the hunt for other water-insects. The nymphs lie concealed in the ground under the water. The perfect insects breathe on the surface of the water, by extending the abdomen above it, and raising the shield-covers a little, whilst the head is kept under.

The intestinal canal does not undergo any remarkable change in the metamorphosis. The four vessels that secrete urine are especially long, the rectum has a lateral appendage, membranous and folded. Below the rectum are the openings of vessels which secrete a milky fluid. RAMDOHR *Abhandl. üb. d. Verdauungswerkz.* s. 79—82, Tab. II. figs. 1—5, LÉON DUFOUR, *Ann. des Sc. nat.* III. Pl. 10, fig. 8.

B. All the tarsi with five joints. First three joints of anterior tarsi in males broad, transverse.

*Colymbetes* CLAIRV. Scutellum conspicuous. (Sub-genera: *Colymbetes, Hybius* ERICHS., *Agabus* LEACH, ERICHS.)

Sp. *Dyt. fuscus* L., PANZER *Deutschl. Ins.* Heft 86, Tab. 5, CLAIRVILLE *Entom. helvet.* II. Pl. 29, fig. B, &c.

*Laccophilus* LEACH. Scutellum covered. Antennæ thin, setaceous.

Sp. *Dyt. hyalinus* DE GEER, *Laccophilus minutus* STURM, *Dyt. obscurus*, PANZER *Deutschl. Ins.* Heft 26, Tab. 3, &c.

*Noterus* CLAIRV. Scutellum covered. Antennæ incrassated in the middle (especially in males).

Sp. *Dyt. crassicornis* FABR., &c.

C. Anterior tarsi in both sexes subequal. (First and second pairs of feet with tarsi of four joints, the penultimate joint obsolete or concealed.)

*Hyphydrus* (ILLIG., GYLLENH. Sp. of *Hydrachna* FABR.), *Hydroporus* CLAIRV.

Sp. *Dytisc. palustris* L., *Dyt. lituratus* PANZER *Deutschl. Ins.* Heft 14, Tab. 4; —*Dyt. rufifrons* DUFTSCHM., STURM l. l. IX. Tab. 207, fig. A, &c.

*Pelobius* SCHOENH., ERICHS. (Species of *Hydrachna* FABR., *Hygrobia* LATR.) Antennæ filiform, short, with eleven joints. Head sub-exsert, with eyes somewhat prominent. Labrum emarginate. Thorax very short, much broader than head. Posterior coxæ narrow. Tarsi all with five joints, slender. Scutellum distinct.

Sp. *Pelobius Hermanni, Hydrachna Hermanni* FABR., PANZER *Deutschl. Ins.* Heft 101, Tab. 1, STURM l. l. VIII, Tab. 200.

*Haliplus* LATR. Antennæ scarcely longer than head, filiform, thin, with ten joints. Labrum entire, with margin ciliated. Posterior coxæ narrow, covered by an orbicular plate. All the tarsi with five joints. (External maxillary palps with last joint narrow, subulate).

Sp. *Haliplus ruficollis, Dyt. ruficollis*, DE GEER *Ins.* IV. Tab. 16, fig. 9, PANZER *Deutschl. Ins.* Heft 14, fig. 10.

*Cnemidotus* ILLIG., ERICHS.

*Note.*—Differs from *Haliplus* in the last joint of external maxillary palps being greater, conical. Sp. *Haliplus cæsus* GYLLENH., PANZER *Deutschl. Ins.* Heft 14, Tab. 7, DÉJEAN et AUBÉ, *Iconogr.* V. Pl. 3, fig. 2.

Family LXIII. *Carabicina* (*Adephaga terrestria, Carabici* and *Cicindeletæ* LATR.). Palps six; maxillæ with double palp (external lacinia palpiform). Mandibles exsert. Maxillæ incurved at the apex. Antennæ thin, filiform. Body mostly oblong, with thorax cordate, oval or quadrate. Abdomen composed of six segments, the three first connate.

A numerous family, in which DÉJEAN in 1839 distinguished nearly 2,800 species, and which with LINNÆUS consisted of two genera *Carabus* and *Cicindela* numbering together, in the last edition of the *Systema Naturæ*, only 57 species.

Compare G. DE PAYKULL *Monographia caraborum Sueciæ*. Upsaliæ, 1790, 8vo; CLAIRVILLE *Entomol. Helvétique*, vol. 2, Zurie, 1806, 8vo; F. A. BONELLI *Observations entomologiques*, 4to, 1809, (*Académ. des Sc. de Turin*); DÉJEAN *Species général des Coléoptères d'Europe*, Tom. I—IV. Paris, 1829—1831, 8vo, &c.

Phalanx I. Ligula porrect (often augmented by lateral appendages or paraglossæ). Apex of maxilla (with few exceptions) without hook distinct, articulate. Labial palps with three joints, set upon labium by means of a peduncle elongate, immoveable. Head not broader than thorax, mostly narrower. Many species apterous. (*Carabicina* in the stricter sense, *Carabidæ* LEACH, WESTW.)

*Running-beetles, earth-beetles.* Most of the species live underground, under stones, under bark of trees. They run very swiftly.

The œsophagus is at its origin narrow, but it soon expands largely; to this crop succeeds the muscular stomach and a long narrow stomach beset with villi, at the inferior extremity of which the four vessels secreting urine are implanted. The small intestine is short, the rectum oval and wide. RAMDOHR, op. cit. pp. 82—84, Tab. III. figs. 7, 8, Tab. XXV. fig. 2, LÉON DUFOUR *Ann. des Sc. nat.* II. Pl. 20, 21.

The larvæ have a longitudinal body, divided into twelve rings, without counting the head. The first ring (*prothorax*) is horny; the last has two conical, horny, or membranous appendages. The head has strong jaws, six simple eyes on each side, and two antennæ consisting of four joints. The six feet are of moderate length, with two hooklets at the extremity.

See figures of the larva of *Carab. auronitens, Carab. hortensis, Carab. depressus,* and *Cychrus rostratus* in O. HEER. *Observ. entom.* Tab. I. II. and

some others carefully collected and published by WESTWOOD, *Modern Classification*, I. pp. 64—71.

*A. External maxillary palps subulate at the apex, with penultimate joint obconical, last conical.*

*Bembidium* LATR. External maxillary and labial palps abruptly subulate, with last joint very small, thin. Elytra entire. Anterior tarsi of male with two first joints dilated. Anterior tibiæ excised at the inner margin. Thorax mostly cordate or subcordate.

*Bembidium flavipes* LATR., *Cicindela flavipes* L., PANZER *Deutschl. Ins.* Heft 20, Tab. 2, CUV. *R. Ani. éd. ill., Ins.* Pl. 25, fig. 9:—*Bembid. quadriguttatum, Carab. quadriguttatus* FABR., PANZER *Deutschl. Ins.* Heft 40, Tab. 5, DUMÉR. *Cons. gén. s. l. Ins.* Pl. 1, fig. 6, &c.

*Note.*—Here belong sub-genera *Cillenum* LEACH, *Blemus* ZIEGL., *Tachypus* MEGERLE, *Lopha, Leja, Bembidium, Notaphus*, and *Tachys* ejusd. Compare DÉJEAN *Spec. gén. d. Col.* V. pp. 31—194.

*Lachnophorus* DÉJ.

*Trechus* CLAIRV. External maxillary palps with last joint acuminate, conical, larger, of the same breadth at the base as the penultimate joint. Anterior tarsi of male with two first joints dilated, triangular. Anterior tibiæ emarginate internally.

Sp. *Trechus rubens, Carabus minutus* FABR., PANZER *Deutschl. Ins.* Heft 73, Tab. 6 (*Carab. tempestivus*), CLAIRVILLE *Entom. helv.* II. Tab. II. fig. 6, B, &c.

*Anophthalmus* SCHMIDT.

Sp. *Anophthalmus Schmidtii* STURM *D. Fauna, Ins.* XV. Tab. 303; 3‴ long, wingless, and without eyes.

B. *External maxillary palps not subulate, with last joint oval, cylindrical or truncated.*

† *Anterior tibiæ not emarginate on the internal side.*

*Elaphrus* FABR. Labrum entire. External maxillary and labial palps filiform, with last joint elongate, truncated. Anterior tibiæ with two terminal spines, the one inserted at the apex, the other before the apex. Eyes globose, somewhat prominent. Body oblong. Anterior tarsi of male with first joints dilated.

Sp. *Elaphrus riparius, Cicindela riparia* L., PANZER *Deutschl. Ins.* Heft 20, Tab. 1, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 2, fig. 6, &c.

*Blethisa* BONELLI (*Blethisa* and *Pelophila* DÉJ.).

*Notiophilus* DUMÉRIL. Labrum rotundate. Anterior tarsi of male with first joints scarcely dilated.

Sp. *Elaphrus aquaticus* FABR., *Cicindela aquatica* L., PANZER *Deutschl. Ins.* Heft 20, Tab. 3.

*Omophron* LATR., *Scolytus* FABR. Labrum transverse, slightly bisinuate. Anterior tarsi of male with two first joints dilated, densely spongy beneath. Body subglobose, with thorax short, transverse, covering scutellum. Feet elongate, thin.

Sp. *Omophron limbatum* LATR., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 2, fig. 2, STURM *D. Fauna, Ins.* VII. Tab. 184. (Genus allied to the *Dytisci*; DESMAREST has observed the larva; see STURM Tab. cit.)

*Nebria* LATR.

*Alpœus* BONELLI.

*Leistus* FROELICH, *Pogonophorus* LATR.

Sp. *Leistus spinibarbis, Carab. spinibarbis* FABR., PANZER *Deutschl. Ins.* Heft 89, Tab. 2, STURM *D. Fauna, Ins.* III. Tab. 70, &c.

*Carabus* L., (in part). Labrum bilobed, sinuate in the middle. Labial and external maxillary palps elongate, exsert, with last joint obconical or subsecuriform. Tibiæ with two terminal spines. Anterior tarsi of male with four first joints dilated, spongy beneath.

*Calosoma* WEBER, FABR. Labrum deeply sinuate in the middle. Mentum with lateral lobes exceeding the middle process. Thorax short, transversely obcordate. Abdomen quadrate, with rounded angles. Wings mostly distinct.

Sp. *Carabus sycophanta* L., VOET *Col.* I. Tab. 37, fig. 32, DUMÉRIL, *Cons. gén. s. l. Ins.* Pl. 1, fig. 4, STURM *D. Fauna, Ins.* III. Tab. 66, fig. *a*. One of our most beautiful native insects, nearly one inch long; head and feet black, thorax violet-steel coloured, the shield-covers gold-green and striated. Both in the state of larva and beetle it belongs to the useful insects from devouring various kinds of caterpillars. See RÉAUMUR *Mém.* II. pp. 455—458, Pl. 37, figs. 14—19, RATZEB. *Forst-Ins.* I. pp. 22—24, 26, 27, Tab. 1, fig. 11.

*Carabus* LATR. Labrum broadly sinuate in the middle. Mentum with middle triangular process extending beyond the lateral lobes. Thorax quadrate, with margins rounded, or obcordate. Abdomen oval. Wings either none or unfit for flight.

Sp. *Carabus auratus* L., VOET *Colcopt.* I. Tab. 36, fig. 29, PANZER *Deutschl. Ins.* Heft 81, Tab. 4, STURM *D. Fauna, Ins.* III. Tab. 55; *Carab. granulatus* L. (*Carab. cancellatus* FABR.), PANZER *Deutschl. Ins.* Heft 85, Tab. 1, &c.

*Procrustes* BONELLI. Labrum trilobate. Labial and external maxillary palps exsert, with last joint securiform. Mandibles strong, denticulate. Mentum with middle process truncated, bifid. Anterior tarsi of male with four first joints dilated, spongy beneath. Elytra connate, wings none.

Sp. *Procrustes coriaceus, Carab. coriaceus* L., PANZER *Deutschl. Ins.* Heft 81, Tab. 1, STURM *D. Fauna, Ins.* III. Tab. 54.

*Procerus* MEGERLE.

*Tefflus* LEACH. (Is this its place?)

*Cychrus* FABR. Labrum deeply bifid. External maxillary and labial palps porrect, with last joint broad, obtrigonal, excavated; internal maxillary palps dilated, cultriform. Mandibles elongate, porrect, denticulate internally. Elytra connate.

*a*) Anterior tarsi of male with two or three first joints dilated.

Sub-genera: *Sphæroderus* DÉJ., *Scaphinotus* LATR., DÉJ.

Compare DÉJEAN *Spec. gen. d. Col.* II. pp. 14—20.

*b*) All the tarsi in both sexes simple.

*Cychrus* LATR., DÉJ.

Sp. *Cychrus rostratus* FABR., *Tenebrio rostratus* L., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 1, fig. 2, STURM *D. Fauna, Ins.* III. Tab. 53.

*Damaster* KOLLAR. (Characters of *Cychrus;* but differs by labrum transverse, only slightly sinuate, mandibles armed at the base with only a single broad tooth). Body elongate. Elytra posteriorly acuminate, dehiscent at the apex.

Sp. *Damaster blaptoides* KOLLAR, *Ann. des Wiener Museum,* I. pp. 333, 334, Tab. 31, fig. 1. Habitat Japan, from whence also the Leyden Museum has received specimens by the traveller V. SIEBOLD.

*Pamborus* LATR.

†† *Anterior tibiæ emarginate on the internal side.*

* *Elytra not truncated at the apex, rotundate.*

a) *Abdomen continuous with thorax, not petiolate.*

α) *Tarsi of first pair in males with first two joints, or three dilated, subquadrate, forming a patella densely spongy beneath.*

*Badister* CLAIRV.

*Licinus* LATR. External maxillary and labial palps with last joint securiform. Mentum exsert in the middle, without tooth.

Sp. *Licinus depressus, Licinus cossyphoides,* STURM *D. Fauna, Ins.* III. Tab. 74, fig. o.

*Dicælus* BONELLI.

*Rembus* LATR.

*Oodes* BONELLI.

*Epomis* BON., LATR.

*Dinodes* BONELLI, DÉJ.

*Chlænius* BONELLI, *Callistus* ejusd.

*Loricera* LATR.

*Panagæus* LATR.

Sp. *Panagæus crux major, Carabus crux major* L., STURM *D. Fauna, Ins.* III. Tab. 73, fig. *a*, A.

β) *Tarsi of four anterior feet in males with three or four first joints dilated, obcordate.*

*Harpalus* LATR.

Sub-genera: *Acupalpus* LATR., *Stenolophus* ZIEGL., *Ophonus* ZIEGL., *Harpalus* DÉJ., *Daptus* FISCH., *Acinopus* ZIEGL.

Sp. *Harpalus ruficornis, Carab. ruficornis* FABR., PANZER *Deutschl. Ins.* Heft 30, Tab. 2; a very common insect in fields and gardens; it hides under stones.

γ) *Tarsi of first pair in males dilated, triangular or obcordate.*

*Zabrus* CLAIRV.

*Pogonus* ZIEGL.

*Tetragonoderus* DÉJ.

*Feronia* LATR.

Sub-genera: *Percus* BONELLI, *Molops* ejusd., *Pterostichus* ejusd., *Abax* ejusd., *Cophosus* ZIEGL., *Cataderomus* MAC L., *Platysma* BONELLI, *Amara* BONELLI, DÉJ., *Pœcilus*. Comp. LATR., *R. Ani.*, *Sec. éd.* IV. p. 393, DÉJEAN et BOISDUVAL, *Iconographie* III.

Compare C. ZIMMERMANN *Ueb. die bisherige Gattung Amara*, in GISTL *Faunus, Zeitschr. f. Zool.* I. 1, s. 1—40;—SCHIÖDTE in KRÖYER'S *Tidskrift* I. pp. 39—65 and p. 99.

Genera: *Myas* ZIEGL., *Cephalotes* BONELLI, *Colpodes* MAC L., *Sphodrus* CLAIRV., BON., *Ctenipus* LATR., *Calathus* BONELLI, *Taphria* BONELLI.

b) *Abdomen petiolate. Antennæ often broken, moniliform.*

*Scarites* FABR.

Add several genera and sub-genera: *Apotomus* HOFFMANS., *Ditomus* BONELLI, *Morio* LATR., *Dyschirius* BONELLI, *Clivina* LATR., *Camptodontus* DÉJ., *Oxystomus* LATR., *Oxygnathus* DÉJ., *Scarites* FABR. in part, *Acanthoscelis* LATR., *Scapterus* DÉJ., *Pasimachus* BONELLI.

Sp. *Scarites arenarius* FABR., *Tenebrio fossor* L., PANZER *Deutschl. Ins.* Heft 43, Tab. 11, CLAIRVILLE *Ent. helv.* II. Tab. VIII. fig. A, *a*.

*Carenum* BONELLI.

*Siagona* LATR.

*Enceladus* BONELLI.

*Ozæna* OLIV., *Morio* LATR.

*Note.*—Add sub-genera *Basoleia* and *Melisodera* WESTWOOD, whom see in GUÉRIN *Magas. de Zool.* 1835, Pl. 132. These coleoptera form the transition to the *carabici* with truncated elytra, with which, according to the opinion of some authors, they would be more correctly classed.

** *Elytra truncated at the apex or obtuse.*

*Truncatipenes* LATR.; a subdivision scarcely to be defined by certain limits, separate from the preceding by negative characters; compare WESTWOOD *Modern Classification* I. p. 75. Tarsi mostly not different in the sexes. Claws of tarsi often denticulate beneath.

Different species of the typical genus of this division, *Brachinus* (*Aptinus* BONELLI), eject for their defence an acrid fluid from the anus, which presently evaporates with an explosion and causes an inflammation on the skin. Hence the name of *Bombardier-beetle.*

ROLANDER gave the first account of this peculiarity in the Transactions of the Academy of Stockholm for 1750. See, on the parts which secrete the fluid, LÉON DUFOUR, *Ann. du Muséum*, XVIII. 1811, pp. 70—81, Pl. 5 (in *Aptinus ballista*), and especially *Ann. des Sc. natur.* VIII. pp. 6—14.

a) *External maxillary palps with last joint oval, acuminate, or rotundate.*

α) *With claws of tarsi simple.*

*Odacantha* PAYK., FABR. Tarsi with fourth joint entire. Head constricted posteriorly. Antennæ moderate.

Sp. *Odacantha melanura, Attelabus melanurus* L., PANZER *Deutschl. Ins.* Heft 10, Tab. 1, STURM *D. Fauna, Ins.* VII. Tab. 178.

*Leptotrachelus* LATR. Sp. *Odacantha dorsalis* FABR.

*Casnonia* LATR.

*Mormolyce* HAGENB. Antennæ elongate, almost of the length of body, with first joint thick, clavate, second very small, third and fourth very long, cylindrical. Head constricted posteriorly, elongate. Elytra marginate, truncated posteriorly, with lobes of margin rounded, produced on each side beyond abdomen. Tarsi with joints entire.

Sp. *Mormolyce phyllodes* HAGENB., GUÉRIN *Iconogr., Ins.* Pl. 6, fig. 7. An insect of remarkable size (2½ inches and more), from the island Java. See J. J. HAGENBACH *Mormolyce, novum Coleopterorum genus,* Norimbergæ, 1825, 8vo, c. Tab. color. (also transferred to *Ann. des Sc. nat.* VI. pp. 500—503, Pl. 21).

*Cordistes* LATR., *Calophœna* KLUG. Tarsi with four first joints cordate. Antennæ almost of the length of body.

Species from South America, *Odacantha acuminata* SCHOENH., *Odacantha bifasciata* FABR. &c.

β) *With claws of tarsi denticulate beneath.*

*Dromius* BONELLI, DÉJ. Mentum bilobed, without middle tooth. Joints of tarsi entire.

Sp. *Dromius quadrimaculatus, Carab. quadrimaculatus* L., &c.

*Demetrias* BONELLI, DÉJ. Mentum bilobed, with middle tooth triangular, broad, small. Fourth joint of tarsi bilobed.

Sp. *Demetrias elongatus* DÉJ., *Carabus atricapillus* L., STURM *D. Fauna, Ins.* VII. Tab. 172, fig. *a*, A.

b) *External maxillary palps with last joint cylindrical, or subincrassated, truncated.*

α) *With claws of tarsi denticulate beneath.*

*Lebia* LATR. Mentum bilobed, no middle tooth. Last joint of labial palps securiform.

*a.* With fourth joint of tarsi bilobed.

Sp. *Lebia cyanocephala*, *Carab. cyanocephalus* L., PANZER *Deutschl. Ins.* Heft 75, Tab. 5.

*b.* With joints of tarsi entire. *Cymindis* LATR.

Add sub-genera: *Plochionus* DÉJEAN, *Calleida* DÉJ.

*Orthogonius* DÉJ.

*Coptodera* DÉJ.

*Ctenodactyla* DÉJ.

*Agra* FABR. Last joint of labial palps very broad, securiform. Mentum with middle tooth. Fourth joint of tarsi bilobed. Body elongate. Head narrowed posteriorly. Thorax elongato-conical.

Species from South America. Compare KLUG *Entom. Monographien*, pp. 9—42, Tab. I. II. and III. figs. 1, 2.

*β) With claws of tarsi simple.*

*Brachinus* WEBER, FABR. Labrum sinuate in the middle, broad, short. Mandibles exsert, with two basal teeth. Mentum with middle tooth mostly none. Tarsi with joints entire. Thorax obcordate, truncated. Elytra broader than thorax, truncated.

Sp. *Brachinus crepitans* FABR., *Carab. crepitans* L., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 1, fig. 5, STURM *D. Fauna, Ins.* VII. Tab. 176, &c.

*Aptinus Bonelli.* Mentum furnished with middle tooth. Wings none. Elytra truncated obliquely. Sp. *Brach. mutilatus* FABR., STURM *D. Fauna, Ins.* VII. Tab. 175;—*Aptinus ballista* ILLIG., GERMAR *Fauna, Ins. Europ.* Fasc. VIII. Tab. 5.

*Corsyra* STEVEN.

*Axinophorus* DÉJ.

*Eucheila* DEJ.

*Catascopus* KIRBY.

*Anthia* WEBER, FABR. Labrum porrect, rotundate. Mandibles large, covered at the base by labrum. Mentum with middle tooth indistinct. Tarsi with joints entire. Thorax obcordate, narrow posteriorly. Eyes somewhat prominent. Wings none.

*Graphipterus* LATR., DÉJ. Ligula in greatest part membranous. Body short. Abdomen broad, oval, almost orbicular.

*Anthia* LATR., DÉJ. Ligula horny. Body oblong. Abdomen elongato-oval.

Sp. *Anthia decemguttata, Carabus decemguttatus* L., VOET *Col.* I. Tab. 38, fig. 45, CUV. *R. Ani., ed. ill., Ins.* Pl. 18, fig. 1; habit. Cape of Good Hope.

*Helluo* BONELLI.

c) *External maxillary palps with last joint obconical or subsecuriform. (Claws of tarsi simple.)*

*Galerita* FABR. Mandibles little exsert, short. Mentum with middle tooth. Thorax elongate, obcordate.

*Zuphium* LATR. (*Zuphium* DÉJ. and *Polistichus* DÉJ., BONELLI.) Joints of tarsi entire.

Sp. *Galerita fasciolata* FABR., STURM *D. Fauna, Ins.* VII. Tab. 174;—*Galerita olens* FABR., CLAIRV. *Ent. helv.* II. Pl. XVII. fig. *a*, A, p. 111, CUV. *R. Ani., éd. ill., Ins.* Pl. 18, fig. 8.

*Galerita* LATR. Fourth joint of tarsi bifid. (Anterior tarsi of male serrate internally, with joints produced into an auricula.)

Sp. *Galerita americana* FABR., *Carab. americanus* L., DE GEER *Ins.* IV. Tab. 17, fig. 21, LATREILLE *Gen. Crust. et Ins.* Tab. 7, fig. 2.

*Drypta* FABR. Mandibles exsert, elongate, narrow, incurved at the apex. Mentum with no middle tooth. Penultimate joint of tarsi deeply bilobed. Thorax oblong.

Sp. *Drypta emarginata* FABR., PANZER *Deutschl. Ins.* Heft 28, Tab. 15, CLAIRV. *Entom. helv.* II. Tab. XVIII. p. 115, STURM *D. Fauna, Ins.* VII. Tab. 179; in south of Europe; lives under the bark of trees.

Phalanx II. Ligula inflected, concealed under mentum, horny, with no paraglossæ. Maxillæ mostly furnished with a hook apical, articulate. Labial palps with four joints, the basilar formed of *stipes* free. Mandibles strong, dentate. Head large, with eyes globose. Anterior tibiæ with internal side entire. Tarsi long, slender. (*Cicindelitæ* LATR., *Cicindelidæ* LEACH, WESTW.)

This division consists in great part of the genus *Cicindela* L. Most of the species live in sandy places and run very rapidly. Whence the name of *Sand-runners, Sand-beetles.* The intestinal canal nearly resembles that of the *Carabi,* but is shorter; the œsophagus is longer.

RAMDOHR *lib. cit.* pp. 84—86, Tab. III. figs. 1—3, 9, 10, LÉON DUFOUR *Ann. d. Sc. nat.* III. Pl. 10, fig. 2; both are figures of *Cicindela campestris*.

The larvæ of *Cicindela* dig for themselves passages underground, and watch for their prey at the entrance of the hole. They suspend themselves in it by two curved hooklets situated on the back at the eighth ring of the body. The head and the first segment are broad and strong, the last inversely cordate.

Compare J. A. WESTWOOD, *Mém. pour servir à l'Hist. nat. de la famille des Cicindelètes. Ann. des Sc. nat.* XXII. 1831, pp. 299—317, Pl. 8; RATZEB. *Forst-Ins.* I. Tab. 1, fig. 12.

A. *Mentum with no middle tooth.*

*Colliuris* LATR., *Collyris* FABR. Body narrow, elongate. Wings distinct.

Sp. *Coll. longicollis* FABR., CUV. *R. Ani., éd. ill., Ins.* Pl. 17, fig. 5; Java.

*Tricondyla* LATR. Body narrow, elongate. Wings none.

Sp. *Tricondyla aptera, Cicindela aptera* TONDER LUND, *Skrivter af Naturh. Selskabet* I. 1790, Tab. VI., GUÉRIN *Iconogr., Ins.* Pl. 3, fig. 2.

*Therates* LATR. Body oblong. Internal maxillary palps very short, uniarticulate.

Sp. *Therastes labiata, Cicindela labiata* F., CUVIER *R. Ani., éd. ill., Ins.* Pl. 17, fig. 4; habit. Islands of the Pacific;—*Therates humeralis* MAC L., habit. Java, &c.—*Habitus* of *Cicindela*.

B. *Mentum with middle tooth.*

a) *Maxillæ with no claw apical articulate.*

*Ctenostoma* KLUG.

Species from South America. Compare KLUG, *Entom. Monogr.* pp. 3—8, Tab. III. fig. 3.

*Stenocera* BRULLÉ, *Pogonostoma* KLUG.

Sp. *Stenocera elegans* BRULLÉ, AUDOUIN et BRULLÉ, *Hist. nat. d. Ins.* Tom. I. Pl. 3, fig. 3; from Madagascar.

b) *Maxillæ supplied with claw apical articulate.*

*Cicindela* L. (in part). Anterior tarsi of male with three first joints dilated.

* *Palps equal.*

Sub-genera: *Cicindela* LATR., *Eupresopus* LATR., DÉJ.

Sp. *Cicindela hybrida* L., PANZER *Deutschl. Ins.* Heft 85, Tab. 4, VOET *Coleopt.* 1. Tab. 39, fig. 1; 5‴ long, the oral organs whitish-yellow, elytra and thorax copper-coloured; on the elytra at the base and apex of each a milk-white spot and a bent transverse band of the same colour in the middle. On a fine summer's day this insect is frequently seen on our sand-hills. *Cic. maritima* DÉJ. differs from this species. *Iconographie et Hist. nat. des Col. d'Eur.* 1. Pl. 3, fig. 3;—*Cicindela campestris* L., PANZER l. l. Tab. 3, RATZEBURG *Forst-Ins.* 1. Tab. 1, fig. 12, &c.

** *Labial palps longer than maxillary.*

Sub-genera: *Oxycheila* DÉJ., *Megacephala* LATR.

*Manticora* FABR. Tarsi not different in the sexes, with joints cylindrical. (Mandibles exsert, strong. Head large. Elytra connate.)

Sp. *Manticora maxillosa* FABR., *Cicindela gigantea* THUNB., DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 2, fig. 4; habitat Cape of Good Hope.

# CLASS IX.

## ARACHNIDS (*ARACHNOIDEA*)[1].

The Arachnids were counted by LINNÆUS, as was stated above (p. 248), to belong to the class of insects. They were first separated from these as a distinct class by LAMARCK (1801), who placed all the wingless insects of LINNÆUS, which undergo no transformation and breathe by air-slits, in his class of the *Arachnida*[2]. To this then the myriapods, spring-tails, and parasites, would also belong, which we have placed amongst the insects (pp. 288—303), and LAMARCK accordingly divides his *Arachinida* into those which have antennæ, and those which are without these parts. It is the last alone, which we, following LATREILLE, refer to this class.

The class of arachnids, thus limited, is a very well defined and natural division of the animal kingdom. The arachnids are articulate animals with articulate feet or legs (see pp. 33, 248) and without antennæ. The head is with them joined to the thorax, so

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[1] For this class we cite especially the following works:

ALBIN Spiders.—ELEAZAR ALBIN, *Natural History of Spiders, illustrated with 33 plates.* London, 1736, 4to.

CLERCK *Aran.*—CAROLI CLERCK *Aranei Suecici descriptionibus et figuris æneis illustrati.* Stockholmiæ, 1757, 4to.

MUELLER *Hydrachn.*—*Hydrachnæ quas in aquis Daniæ palustribus detexit, descripsit, pingi et tabulis XI. æneis incidi curavit* O. F. MUELLER. Lipsiæ, 1781, 4to.

HERM. *Mém. apt.*—*Mémoire apterologique par* J. F. HERMANN. Avec 9 Pl. enlum. Strasbourg, 1804, fol.

WALCKEN. *Aranéid.*—*Histoire naturel des Aranéides par* C. A. WALCKENAER. Paris et Strasbourg, 1806. (5 parts in 12mo, with col. fig. in the taste of PANZER *Deutschl. Ins.*)

SUNDEV. *Conspect.*—C. J. SUNDEVALL *Conspectus Arachnidum.* Londini Gothorum, 1833, 8vo.

HANN u. KOCH *Arachn.*—C. W. HANN *Die Arachniden, getreu nach der Natur abgebildet u. beschrieben.* 1, 2. 8vo. Nürnberg, 1831—1835; C. J. KOCH *Die Arachniden* (continuation of HANN'S work). Nürnberg, 1836—1846. 3—12 vols.

KOCH *Deutschland's Arachniden,* in HEBRICH-SCHÆFFER'S continuation of PANZER'S *Deutschl. Ins.* (*Acari*).

KOCH *Uebersicht.*—C. J. KOCH *Uebersicht der Arachniden-Systems.* Nürnberg, 1837—1847 (4 parts with plates).

WALCKEN. et GERV.—*Histoire naturelle des Insectes aptères.* 4 vol. Paris, 1837—1848. (*Suites à* BUFFON *chez* ROBET; the first three parts; the third is by GERVAIS.)

[2] *Système des Animaux sans vert.* p. 171.

as to form a single piece, to which LATREILLE has given the name of *Cephalothorax*: to this piece alone are the feet attached. Behind the *cephalothorax* is connected with the abdomen, the second principal piece of the body. A longitudinal arterial heart or dorsal vessel is present, and in many a more or less developed vascular system for the circulation of blood. Respiration is effected either by means of air-tubes, as in insects, or of lungs in determinate parts of the body. In all, however, there are lateral openings or air-slits (see above, p. 260, 261), which conduct to the respiratory organs. The sexes are distinct.

According to the theory of SAVIGNY, no oral parts are present in this class, which correspond to the upper and lower jaws of insects. The parts, which in spiders and scorpions are usually called upper jaws (*mandibles*), are, according to SAVIGNY, to be compared with the second pair of *auxiliary* jaws, or feet changed into jaws in the cray-fish and other ten-footed crustaceans. In some arachnids these parts undergo such a change, that they assume a flattened form and compose a sucker. The under-jaws which succeed these, and which in the scorpions sustain large shear-shaped feelers, are, according to SAVIGNY, to be compared with the third pair of auxiliary jaws, or feet changed into jaws of decapod crustaceans. To these, in the arachnids, four pairs of feet succeed, of which the first pair, according to the same writer, corresponds to the second pair of untransformed feet of decapod crustaceans. The untransformed first pair of feet of the decapod crustaceans, the so-called *chelæ* or shears of cray-fish and crabs, would thus, like the proper jaws (*mandibles*), be wanting in arachnids[1]. The abdomen is never provided with feet.

[1] This view, however, is not altogether free from objection. Thus LATREILLE considers the first pair of jaws (the upper-jaws) of arachnids to be modified antennæ. [ERICHSON rejects this opinion of LATREILLE; *Entomographien*, erstes Heft. Berlin, 1840, s. 9; OWEN, on the contrary, on the ground of the origin of the nerves distributed to these parts, defends it. Lectures on *Comp. Anat.* I. 1843, p. 253, 2nd edit. p. 448.] Still more may it be doubted whether the first pair of feet of arachnids really corresponds to the second pair of unaltered feet in decapod crustaceans; this comparison may be looked on as merely an arbitrary conception. Rather does the opinion deserve the preference, that these parts correspond to the lateral parts of the under-lip. [This opinion, I think, was first offered by W. DE HAAN in an essay, of which the other propositions appear to me to be less happy, entitled: *Vergelijking tusschen de tast-kaauw-en bewegings-werktuigen der gelede dieren* in VAN HALL, VROLIK and MULDER, *Bijdragen tot de natuurk. Wetensch.* II. 1827, bl. 134, afterwards by DUGÈS *Ann. des*

The feet or legs of arachnids do not present exactly the same *typus* as those of insects. They consist usually of seven joints, and are not thinner towards the extremity, so that the *tarsi* differ less from the other parts than in insects. If we suppose that the two last joints belong to the tarsus, then the tibia consists of two joints of which the first in some is the longest (*e. g. Scorpio* and *Phrynus*), in others the second. The long joint that precedes it is the *femur* which succeeds a short, inversely conical joint corresponding to the *trochanter* in hexapod insects. The first joint, broader, commonly inversely conical, by which the feet are attached to the cephalothorax, corresponds to the hip (*coxa*) of insects. In *Phrynus*, the tarsus of the fore legs consists of a great number of joints (thirty and more), of extraordinary fineness, and in the remaining feet of three joints. The last joint of the tarsus has usually two curved hooklets, and in some a membranous or vesicular cushion (*pulvillus*) in addition at the under side. What is most distinctive in the composition of the feet in arachnids, is the division of the tibia into two pieces. In *Phrynus*, the tibia of the fore-feet, like the tarsus, consists of numerous thin joints; those of the second and third pairs of feet of the usual number, two; those of the fourth pair of five, of which the first exceeds the rest in length remarkably.

The *cephalothorax* often presents a line or groove on each side of the simple eyes placed in the middle, indicating an imperfect separation, so that the head looks like a wedge or triangle, with the point turned backwards, upon the thorax. The upper surface of

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*Sc. nat.* 2e Série, I. *Zoolog.* p. 7, and by ERICHSON, *Entomogr.* s. 8.] In the scorpions there are two horny triangular plates between the first pair of feet, which may be regarded as *mentum*, a part wanting in the rest of the anaehnids. An upper lip (*labrum*) is not present in these any more than in the rest. According to this view arachnids would have only three pairs of feet, like most insects. Yet Zoology must nevertheless still continue to assert that arachnids have four pairs of feet, since, in reality, four pairs of jointed appendages of the *cephalothorax* do always act as feet. Even the jaws of hexapod insects are in a wider sense modified feet. Feet and jaws are parts having the same fundamental form. This is proved by the history of development. Both these parts are, according to the investigation of RATHKE in the Cray-fish, of the same form, and the dissimilarity between feet and jaws, which is seen in perfect cray-fishes, is merely the consequence of subsequent development (*Untersuchungen über die Bildung u. Entwickelung des Flusskrebses*, Leipsig, 1829, fol. s. 67, 68). In young and still imperfect individuals of *Cyclops quadricornis*, according to the figures of JURINE, the upper jaws and the last pair of under jaws serve for swimming, and have much resemblance to the feet which are developed only at a later period. RATHKE loc. cit. p. 73.

the thorax consists of a lamina, in which sometimes, more or less obviously, four sutures or grooves are seen, which proceed obliquely from the feet to the center, and indicate the original composition of the thorax of four pieces. On the under surface, between the coxæ of the feet, is a lamina, which may be considered as *sternum*, formed of the union of four pieces. The abdomen of the Scorpions, of *Phrynus* and *Telephonus* and (amongst the *Arachnoïdea trachearia*) of *Obisium* is divided into rings; in others, as the spiders, it is without rings, and has a much softer integument than the cephalothorax. On the whole, the external covering of the Arachnids is soft and very extensible; the skin is horny and hard in *Scorpio*, *Phrynus*, in some *Epeiræ* (*Epeira cancriformis*), &c. Two layers may usually be distinguished in the skin; the external is firmer, sometimes cellular, often provided with sinuous folds; the internal consists of a finely granular substance or of very delicate fibres, beneath which is a layer of pigment. In *Mygale*, these pigment cells are very apparent. The external membrane exhibits many concentric rings with spots between them, which, under the microscope, present a deceptive resemblance to the corpuscles and lamellæ of bone.

The intestinal canal of the arachnids proceeds without tortuosities to the posterior extremity of the body. Not in all of them, however, is the *anus* situated at the posterior extremity, but in the *Acari* more forward on the ventral surface[1]. In *Phrynus* and *Scorpio*, the intestine is a narrow canal, nearly of the same width throughout. In all the other Arachnids, the intestinal canal has many protrusions or blind appendages of very different form; and in many *Acarina* these appendages are ramified, reminding us of the form of the intestine in *Planariæ* and *Distomata*. In the *Pycnogonida* blind appendages proceed from the stomach, even into the shear-shaped feelers and the feet. In the genus *Phalangium* the intestinal canal forms a wide sac, which has in front, on each side, five blind appendages that become wider towards the extremity, of which the last pair is longer than the rest, and descends to the termination of the intestinal canal. Between these appendages are still twelve others smaller and vesicular, and at the hindmost part

[1] See the figure of *Ixodes*, *Acarus americanus* (or *crenatus* KOLLAR) in TREVIRANUS, *Zeitschr. für Physiol.* IV. 2. 1832.

of the intestinal canal there are in addition four small blind appendages on each side[1]. In the spiders (*Aranea* L.) the œsophagus is narrow, horny, bent first downwards, then upwards, and terminates in a part which proceeds backwards, and can be dilated by muscles attached to it[2]. This part becomes at its extremity more membranous, and passes into the intestinal canal, which sends two lateral arms forwards that bend themselves round in the cephalothorax and approach each other or unite so as to form an annular stomach. From this ring blind eversions proceed towards the feet, bend downwards, and communicate with each other. From the same point where the two lateral arms arise a middle canal exists, which runs towards the abdomen and is gradually dilated in some degree. The widened part receives on each side two large canals which branch through the adipose body; the intestinal canal then narrower curves upwards and afterwards proceeds downwards, where, previous to its termination, an oval cœcum is situated laterally.

Organs of different form for the secretion of saliva are observed in most genera of this class, and probably are wanting in none of the arachnids, although their opening into the intestinal canal has not been detected in all. In the Scorpions, where MECKEL[3] denied altogether the existence of salivary organs, two longitudinal sacs placed in the fore part of the abdominal cavity, their tortuous canals running forwards in the cephalothorax, probably serve for the secretion of saliva[4]. From the secretion of saliva the poison should be distinguished, with which different species kill their prey previous to devouring it. In the spiders there is situated at the base of each of the mandibles, or sometimes in the mandibles themselves, a vesicle, surrounded by a layer of flat spirally turned filaments, from the anterior part of which a narrow duct arises, that runs towards the point of the upper jaw. This poison has an effect

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[1] RAMDOHR *Verdauungs werkz. d. Ins.* s. 204, 205, TREVIRANUS *Verm Schr.* I. s. 29—31, Tab. III. figs. 16, 17, TULK in *Ann. of nat. Hist.* XII. 1843, pp. 246—248. Pl. IV. fig. 17.

[2] TREVIRANUS, in his work *Ueber den innern Bau der Arachniden*, s. 29, 30. Tab. II. fig. 24, has described the intestinal canal imperfectly. BRANDT *Mediz. Zool.* II. has partially improved on him. We follow here especially WASMANN in *Abhandlungen herausgegeben von den naturwissensch. Verein*, Hamburg, 1846. I. 4to. s. 142—144.

[3] *Syst. der vergl. Anatom.* IV. s. 145.

[4] J. MUELLER in MECKEL'S *Archiv f. Anat. u. Physiol.* 1828. s. 52.

often rapidly mortal upon those insects on which spiders feed, and even large flies die quickly when they have been wounded on a single foot alone by the bite of *Clubiona atrox*[1].

We have seen that in the spiders, from the dilatation of the intestinal canal situated in the abdomen, which might be taken for the hindmost stomach, large canals proceed to the adipose body. Similarly in the scorpions from the intestinal canal, at nearly equal and very large distances from each other, there arise on each side five transverse branches which subdivide into finer branches and run through the granular adipose mass. Already, when treating of the Class of Insects, we directed attention to the suggestion that there perhaps the adipose body assumed the place of the liver (p. 257). In most arachnids (*Scorpio*, *Aranea* L.) this part certainly, with still stronger claim, deserves to be thus considered[2]. It consists of lobes, formed of small blind vesicles united in clusters, and filled with cells. The ducts in question, which run towards the intestinal canal or proceed from it as branching eversions, are to be considered then as gall-ducts. In other arachnids (*Phalangita*, *Acarina*, *Arctisca* and *Pycnogonida*) the glandular walls of the blind intestinal appendages probably serve for the secretion of bile[3].

In most arachnids there exist also thin tubes with blind extremities which correspond to the *Malpighian vessels* of insects (see above, pp. 255, 256), and so are to be considered as subservient to the urinary secretion. They differ, however, from the vessels of insects alluded to, inasmuch as they usually divide into many branches.

The organs for respiration and the circulation of blood are not in these animals formed after one and the same type. When respiration is performed by means of air-tubes, there is a dorsal vessel, as in insects, a longitudinal heart, without branches; vessels, on the other hand, are found in those genera in which the respiratory organs are sacciform lungs, and are not spread throughout the body as air-tubes. In *Phalangium*, the heart is a dorsal vessel without branches, which becomes narrower at both extremities, and is divided by constrictions into three chambers, or dilata-

[1] TREVIRANUS, *Ueber d. inn. Bau d. Arachn.* s. 31, 32, Tab. 2, figs. 21, 22.

[2] J. F. MECKEL *Beyträge z. vergl. Anat.* 1, 2. 1809. s. 108. See also especially WASMANN l. c. pp. 145—148, Tab. 13, figs. 20—22.

[3] V. SIEBOLD, *Lehrb. der vergl. Anat.* 1. s. 529.

tions[1]. In many of the inferior arachnids neither heart nor vessels have been met with.

In the spiders and scorpions, on the contrary, there are vessels present for the circulation of the blood. The heart has, indeed, still the form of a longitudinal vessel, but other vessels arise from it, whilst from the respiratory organs the returning arterialised blood penetrates the heart through lateral, transverse fissures on the upper or dorsal surface, which are provided with valves. The course of these returning vessels, corresponding to the pulmonary veins of the human body, is not yet perfectly understood. Probably the whole heart is surrounded by a *sinus*, into which the arterial blood is poured, before it penetrates the above-mentioned fissures. Vessels also from the heart proceed to the respiratory organs, but these probably serve for their nutrition, and not for respiration. The heart of arachnids is then, beyond doubt, an arterial heart, like that of *crustacea* and of *mollusca*[2].

We have already said that the respiratory organs are in some arachnids air-tubes, in others pulmonary sacs. In both cases the air has access to the respiratory organs by air-slits (*stigmata*), as in insects; but these stigmata are always in less number than in most insects. In some arachnids no respiratory organs at all have been discovered (*Pycnogonum*, the so-named *tardigrada*, many *Acari*). In these also no stigmata are present. Sometimes, indeed, parts have been taken for stigmata, which have an entirely different signification; I allude to two rows of spots on the back, which are for the attachment of muscles, which, connecting the dorsal and ventral surfaces, contract the abdomen, and which we also meet with again in *Limulus*, amongst the *Crustacea*[3]. In the scorpions

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[1] TREVIRANUS *Verm. Schr.* I. s. 31, Tab. III. fig. 18, TULK l. c. p. 249, Pl. IV. fig. 17 *a''*, *H*, *p*.

[2] The most complete description of the heart and vessels of the scorpions has been given by NEWPORT in *Phil. Transact.* for 1843, Part I. pp. 286—298, with beautiful figures. From the dorsal vessel, that as an aorta springs from the heart at the fore part, there arises, before the origin of the arteries for the last pair of feet, an artery on each side, which passes beneath the œsophagus; the two form a single vessel lying on the nervous cord. It is this artery which was described by TREVIRANUS as a third nervous cord, and by MUELLÆR as a ligament. Under the nervous cord in the abdomen a venous trunk is situated.

[3] This mistake was made even by the celebrated TREVIRANUS in *Chelifer* (*Verm. Schr.* I. s. 18, 19, Tab. II. figs. 6, 7, A), who could not on that account find any air-tubes there.

the air-slits are obliquely transverse fissures on the ventral plates of the abdomen. The uppermost or anterior lip of these slits covers in some degree the lower, from which last a membranous margin arises, which bears the respiratory organ situated in a small cavity. This lung (or gill) consists here, as in spiders, in *Thelyphonus* and *Phrynus*, of a number of double, very thin plates lying upon each other. If now, as is asserted, the air on respiration really penetrates this chamber so as to fill the spaces between the duplicatures, then the name of lung would be justifiable[1]. The ordinary position of the stigmata is on the inferior surface of the uppermost part of the abdomen. There also AUDOUIN discovered four stigmata in the genus *Chelifer* that breathes by air-tubes[2]. The *Phalangia* that also breathe by air-tubes have only a single pair of stigmata. In *Ixodes* LYONET and AUDOUIN found the two stigmata furnished with a plate, and upon it, besides a larger opening, many other smaller ones with a stellate margin[3]. In spiders also the stigma is not always a simple fissure, as in the scorpions, but is sometimes closed by a plate perforated like a sieve[4]. The tracheæ of arachnids differ often from those of insects by the absence of the spiral thread. Usually also they are parcelled in bundles, and not divided into branches. However, in *Phalangium*, a system of air-tubes is met with divided into branches and spread throughout the body, and provided also with a spiral thread. There are two wide principal stems which, running forwards in the cephalothorax obliquely towards each other, divide into branches, whilst a transverse branch on the inside, behind the thoracic ganglion, forms an arch by uniting with that of the opposite side. In the abdomen, behind the stigmata, the lateral principal branches do not continue their course, but three smaller branches alone from the principal stem penetrate backwards on each side[5].

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[1] Not on account of respiring in air; for all animals that live in air have not lungs, the land-crabs, for example, have gills. The respiratory organs of the *Holothuriæ*, on the other hand, although these animals inhale water, are formed after the *typus* of lungs.

[2] *Ann. des Sc. nat.* XXVII. 1832. p. 62.

[3] LYONET *Rech.* Pl. 6, fig. 5, AUDOUIN, *Ann. des Sc. nat.* XXV. p. 419, and TODD'S *Cyclopædia* I. p. 205.

[4] LYONET, l. l. Pl. 10, fig. 10.

[5] TREVIRANUS *Verm. Schr.* I. s. 32, 33, Tab. IV. fig. 19, and especially TULK l. c. pp. 327—329. Pl. V. fig. 33.

The male and female organs of propagation are, with the exception of the *Tardigrada*, in all arachnids distinct, and not united in the same individual. The ovaries are usually two sacs that are sometimes connected in the middle; the oviduct is constantly an immediate continuation of the ovary. In *Phalangium* the ovary consists of a tortuous, circular tube connected with a wide sac, in which the eggs await for a time their further development. From this sac a second oviduct arises, which running tortuously first backwards then forwards, terminates in the ovipositor. This ovipositor consists of horny transverse filaments, bound mutually together by a tough elastic membrane. It can be protruded by muscles through the external sexual opening situated between the hind feet[1]. In the scorpions, the internal female organs of propagation consist of three tubes running longitudinally; the middle tube is united with the lateral by three transverse branches; the two lateral tubes, moreover, unite with each other in an arch below. They extend farther forwards than the middle tube and thus form two oviducts as their immediate continuation, which open at the external sexual aperture under a valve between the base of the third and fourth pair of feet. Here each of these oviducts, before it terminates, forms a roundish expansion, which may be considered as a *receptaculum seminis*[2].

The male organs of propagation consist of two blind saccules or two tortuous and blind canals; in others of two bundles or of a single group of numerous blind saccules or tubules, as in *Phalangium*. In the scorpions two loops or tortuous strings of a narrow canal, with two transverse canals, are found. The *vas deferens* also receives the openings of two blind sacs before reaching the external sexual aperture, which is in the same situation as that of the female. Here is

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[1] TREVIRANUS ibid. s. 47—49, Tab. v. fig. 28, Tab. vi. figs. 32, 35, TULK l. c. pp. 318—324. Pl. v. figs. 26, 27, 28.

[2] V. SIEBOLD (*Lehrb. der vergl. Anat.* i. s. 548) found in it *Spermatozoa* in living females. Comp. on the described *Ovaria* in *Scorpio*, MUELLER in MECKEL'S *Archiv f. Anat. u. Physiol.* 1828. s. 54, 55, Tab. ii. fig. 16. In the developed state of the ovary, pear-shaped eversions proceed from these tubes of the impregnated female. MUELLER saw these in the form of elongate blind sacs, in the middle excavated like a bean. In this wider part the embryo of the scorpion is contained. I also have met with the ovary of *Scorpio reticulatus* from Java in the developed state. Scorpions are viviparous, of which mention was made already by the ancients; ARISTOTELES *Hist. Anim.* v. cap. 25, ÆLIANUS *de Animal. nat.* Lib. v. cap. 20.

found a small papilla, which may be considered as the rudiment of a *penis*. Also in some Acarina a short penis is present. In *Phalangium*, on the other hand, there is a long horny penis which can be extended from the body at the same part as the ovipositor in the female, and through which the *ductus ejaculatorius* extends; at the upper extremity of the glans is a small hooklet. In the spiders the two efferent vessels, arising from the blind tubes that secrete the seed, run towards the base of the abdomen, where they open, without any copulative organ, between the gills. The organ of copulation lies very distant from this opening. In the spiders, namely, the last joint of the feeler is excavated like a spoon, with various appendages in addition, different in different species, and a horny, curved filament connected, which lies concealed in the excavation, and can be extruded from it. With this club of the *palpi*, the male, at the time of pairing, touches the sexual parts of the female, having previously moistened it with a drop of seminal fluid from the opening of the vasa deferentia. This is thus the copulation itself, and by no means, as TREVIRANUS supposed, a preliminary sport to excite the sexual passion: this is the copulation itself, which LISTER, DE GEER, LYONET, and others, described so fully and so interestingly[1]. The danger of being cruelly put to death by the female spider causes the male to make his approaches to her with anxious caution, and after the congress to betake himself rapidly to flight.

In the development of the arachnids from the egg, after the germinal vesicle has disappeared, there appear to occur, as in many other animals, clefts and grooves in the yolk-mass. The germinal membrane or disc grows slowly round the yolk, closing finally on the dorsal surface. Before this closure is completed, the commencement of the embryo appears on the ventral surface of the yolk. Here are seen, at least in the embryo of the scorpions according to the observations of RATHKE, different thickenings lying in pairs near each other in a row, which are the beginnings of the segments of the body. From the mucous layer of the germinal membrane arises the intestinal canal, which at first is not

[1] See, for instance, LYONET in his translation of LESSER *Théol. der Ins.* I. p. 184, and in his *Recherches*, pp. 73—75, and WALCKENAER *Hist. nat. des Aranéides*, v. 8, respecting *Theridion benignum*. See also OWEN *Lectures on comp. Anat. of invert. Anim.* p. 264, 2nd ed. p. 462.

separated from the yolk, afterwards lies between two lateral portions of the yolk, which, by transverse indentations, change into cœcal sacs placed in pairs. These sacs, in connexion with the intestinal canal, are the rudiments of the biliary vessels and of the liver. The yolk changes into the liver, or the so-called adipose body. The limbs arise as conical appendages placed under the ventral surface, with the extremities turned downwards towards each other. On the dorsal surface of the yolk is seen a streak running longitudinally as the rudiment of the heart, that is at first without vessels. The nervous system, in its central parts, is formed at a still earlier period, and the cerebral ganglion is in the beginning proportionally much larger than it is afterwards[1].

We have already said that the scorpions are viviparous. With the egg-laying spiders, the egg, under the changes of development, slowly loses its previous form, and almost assumes that of a spider, indicating all the external parts of the inclosed animal. At length the shell bursts on the thorax, and the spider, first with the head, and afterwards with the thorax, comes to view; then follows the abdomen, to which however the egg-membrane, like a scale, continues attached for a time; then come the feelers and feet[2]. The young spider, through whose integument the granules of the yolk may be clearly distinguished, is not yet in a state to weave a web and catch its prey; for the spinning organs are still concealed beneath the common integument. After the lapse of a week, or, in some species, a longer time, during which the spider takes no food, it casts its skin for the first time, and is, as it were, born for the second time. The young spiders now quit, on some mild day in May or June, the web in which the mother had hidden her eggs; they allow themselves to fall on the ground by a thread, and begin at once to weave their nets, or in some other way, according to the instinct of their kind, to watch for small insects corresponding to their age and powers.

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[1] On the development of spiders see M. Herold *De Generatione Aranearum in Ovo*, Marburgi, 1824, fol. cum tab. æneis: De Wittich *Observationes de Aranearum ex ovo evolutione*, Hallæ, 1845; of scorpions, H. Rathke *Zur Morphologie*, Riga u. Leipzig, 1837. 4to. pp. 17—34. Pl. I. figs. 1—11; compare also the shorter description of these last observations and of those of Herold in Burdach *Die Physiologie als Erfarungswissenschaft*, 2te Ausg. II. 1837. s. 242—248.

[2] De Geer *Mém. pour servir à l'Hist. des Ins.* VII. pp. 195, 196, Pl. 18, figs. 11—14.

Most arachnids feed on other animals, which they either swallow alive, or whose blood and fluids they suck. Usually, after their escape from the egg, they undergo no metamorphosis. They cast, however, their skin more than once, and are commonly, after the fourth or fifth moult, in a state for pairing. In most *Acarina*, the young animals are at first supplied with only three pairs of feet, which gave occasion to some writers to adopt some six-footed *genera*, which were afterwards rejected as unfounded. The *Pycnogonida* and the genus *Hydrachna* present the most interesting changes of form, of which the most remarkable particulars will be noticed in the systematic arrangement of these animals.

The power of reproduction in arachnids is commonly, as in the preceding class, considered to be small[1]. In many, however, lost feet can grow again. Thus GEOFFROY once saw a Phalangium, in which one foot was less than the remaining seven[2], and which probably might have grown at a later period. At all events it is established that, in spiders, lost feet are regenerated[3]. In animals, whose growth is limited, *i.e.* which do not grow after they are capable of propagating, I think the reproductive power, in this full-grown state, is small. In such a case are insects after their last metamorphosis (see above, p. 276), but by no means spiders and crustaceans.

Very various is the form of the nervous system in the arachnids. In the greatest number there is a large ganglion in the thorax (*cephalothorax*), formed, as it seems, by the coalition of different other ganglia, from which the nerves for the under-jaws and *palpi*, and for the four pairs of feet, radiate. At the posterior margin of this ganglion arise, under acute angles, close to each other (as in the *cauda equina* of mammals), the nervous trunks for the abdomen. The two middlemost are sometimes thicker, lie closer together, and unite towards the extremity, before dividing, to form a ganglion

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[1] MECKEL'S *Syst. der vergl. Anat.* I. S. 121.

[2] *Hist. abrégée des Ins.* I. p. 629.

[3] See an observation of the celebrated BANKS, interesting also in other respects recorded by LEACH *Trans. of the Linn. Soc.* XI. 1815, pp. 393, 394; see also HEINEKEN'S experiments and observations, *Zool. Journal*, IV. 1829, pp. 284, 294, and those of LEPELETIER and AUDOUIN in TODD'S *Cyclopædia*, I. pp. 214, 215. Spiders must, however, lose the entire foot as far as the *coxa;* if it be broken off lower the spider dies, unless it succeed in breaking off the stump that is left. The new foot (at first very short) makes its appearance at the next moult.

(*Telephonus*), or lying side by side form an abdominal cord without ganglia, as in the spiders. A chain of ganglia, as in most insects, is found in *Tardigrada*, in *Pycnogonida*[1], and in *Scorpio* alone. In the *Pycnogonida*, the four ganglia, forming the row, lie close together, without connecting cords, just as SWAMMERDAM has figured the nervous system in *Pediculus* (see above, p. 301). In *Scorpio*, on the contrary, they lie, seven in number, at considerable distances apart, and are connected by two strings[2]. Above, and commonly close upon the thoracic ganglion, is placed a ganglion which may be considered as cerebral ganglion; in very simply organised arachnids it is seen as a simple commissure on the œsophagus; in others it is oblong and formed of two small parts, mostly conical or pear-shaped, lying side by side. From it arise the nerves of the mandibles and of the eyes. Between this cerebral ganglion and the thoracic ganglion, there is always an opening, mostly very narrow, for the passage of the œsophagus, which is surrounded on each side by the nervous connexion of the two ganglia. That the first ganglion is smaller than the second, and not broad, as in most insects, depends, without doubt, principally upon the absence of the compound eyes, whose nerves, in insects, have such a large development. Interesting also is the exceptional form of the nervous system in *Phalangium*, where the nerves proceeding from the thoracic ganglion form eight ganglia in their course, four on each side, not behind one another in a row, but at different heights, dispersed on each side of the body, and distant from each other[3].

Traces of a distinct nervous system for the intestines, of that system which we indicated above, in insects, as answering to the

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[1] QUATREFAGES *Ann. des Sc. nat.* 3ième Série, IV. 1845. *Zoologie*, p. 77, Pl. I. and II.

[2] TREVIRANUS *Ueb. d. inn. Bau der Arachn.* s. 14—16, Tab. I. fig. 13, and especially *Zeitschr. für Physiol.* IV. 1831. s. 89—97, Taf. VI. and the elaborate fig. of NEWPORT *Phil. Trans.* 1843, Part I. Pl. XII. That the nervous system in *Phrynus* and *Telephonus* is formed not after the type of the scorpions, but of the spiders, was announced by me in the *Tijdschr. von Nat. Gesch. en Physiol.* IX. 1842, bl. 75, and X. 1843, bl. 369, 370. In *Telephonus*, at least, it would be difficult to have anticipated this, and it is also in contradiction to the rules, already contradicted indeed by other instances, which STRAUS DURCKHEIM formerly laid down for the form of the nervous system of articulate animals. *Consid. gén. s. l'Anat. comp. des Ani. art.* pp. 364, 365, 371.

[3] TREVIRANUS *Verm. Schr.* I. s. 38, 39, Tab. IV. fig. 24, TULK I. l. p. 325, Pl. V. fig. 31.

*nervus sympatheticus* (p. 278), are only imperfectly recognised. There has been found, in spiders and scorpions, a nerve that runs towards the stomach, and arises by two thin roots from the posterior margin of the cerebral ganglion[1].

The organs of sense in arachnids are limited, as far as they are known, to those of sight and feeling. A distinct organ of hearing has not yet been discovered. The seat of taste, probably also of smell, is to be sought for perhaps in the commencement of the intestinal canal. For feeling the *palpi*, in many at least, officiate; in others, where, as in *Scorpio* and *Chelifer*, they are covered with a hard skin and are shaped like shears, they serve for seizing prey. The long feet also of spiders and of *Phalangia*, and especially the thread-like feet of the first pair in *Phrynus*, are peculiarly adapted for organs of feeling. The eyes are constantly simple. Behind the convex cornea is placed a very round lens, which is received by a vitreous humour concave on the anterior surface. Behind this humour lies the retina, surrounded by a coloured pigment of the *choroïdea*, which at the fore part, between the lens and the vitreous humour, forms a ring like an *iris*. For the presence or absence and the number of simple eyes, we refer to the systematic arrangement of the class. Often, as in *Scorpio*, *Phrynus* and *Telyphonus*, two simple eyes are placed close together in the middle, and on each side two groups of smaller simple eyes towards the margin of the *cephalothorax*. If this disposition be compared with that of insects, then the middle eyes may be likened to their simple eyes, and the two lateral groups to their two compound eyes.

The muscles of the arachnids are principally inserted in the external integument. The cavity of the cephalothorax is especially occupied by a mass of muscle, because the limbs, which are moved by the muscles, are placed in a circle round about that part. In spiders there is found here, for the attachment of the muscles, in addition, an internal oblong plate, tendinous, hollow above, and with the anterior margin excised. This part was already observed by LYONET[2]. It was also found by me in *Phrynus*, and in the

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[1] BRANDT *Med. Zool.* II. s. 90, NEWPORT l. l. p. 261.

[2] *Recherches sur l'Anat.* &c. *Ouvrage posthume.* p. 100, Pl. 10, fig. 26, TREVIRANUS *Ueb. d. inn. Bau der Arachn.* s. 30, Tab. II. fig. 23. TREVIRANUS calls this part incorrectly a cartilage (*Knorpel*).

class of the *crustacea* occurs largely developed in *Limulus*. The name of inner *sternum* has been given to it; it occupies in some degree the place of the *entothorax* in insects, is not however a horny part penetrating inwards from the integument, but a production from the numerous interwoven tendons of the different muscles which mutually meet there[1].

Arachnids are met with in every quarter of the globe. I am acquainted with no families or principal groups (larger *genera* in the sense of LINNÆUS) which, as is the case in other classes, belong exclusively to the eastern or the western hemisphere. The larger arachnids inhabit warm regions, especially the genera *Scorpio*, *Mygale*, *Telyphonus* and *Phrynus*. By far the most of the animals of this class live on land, others in fresh water, in the sea only very few, just the reverse of what we remark in the crustaceans.

[1] A similar part is the *linea alba*, for the abdominal muscles of mammals.

# SYSTEMATIC

# ARRANGEMENT OF ARACHNIDS.

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## CLASS IX.

### ARACHNOIDEA.

ARTICULATE animals with articulate feet. Head and thorax conjoined to form a single part. Feet eight, placed at the sides of cephalothorax; abdominal feet none. Heart placed in the back, resembling an elongate vessel, in many giving off arteries. Respiration in some tracheal, in others pulmonal; in some no distinct organs of respiration. Sexes mostly distinct.

Section I. *Tmetothoraca* s. *Apneusta.* Cephalothorax divided into four segments. Stigmata none. Organs of respiration none. (Seat of respiration either in the external integument of body or in the digestive canal.)

#### ORDER I. *Polygonopoda.*

Feet elongate, of the length of body or longer than body. First segment of body tubular, exsert, perforated at the apex by the mouth. Ocelli four in a tubercle behind the tube at the middle part of the second segment. Abdomen small, conical.

Family I. *Pycnogonida* (characters of the order).

*Sea-spiders.* The genus *Pycnogonum* of BRUENNICH (*Polygonopus* PALLAS), with some other allied genera of later writers, forms a small group of marine animals, on the true place of which in the natural arrangement opinions differ; for MILNE EDWARDS, and especially QUATREFAGES and KROEYER, refer them to the crustaceans. That some of these animals live parasitically on whales and other

marine creatures appears to be a mistake[1]. They are dull animals living on the beach under stones, or on marine plants. They undergo, according to the observations of KROEYER, a remarkable metamorphosis, and have at first only two pairs of short feet, and a short, thick, undivided body. Afterwards a third pair of feet, still short, appears, and only in a succeeding state is the fourth pair added to them.

That division of the body which lies in front of the first pair of feet and bears the eyes above, is in some more, in others less distinctly distinguished from the first ring of the thorax. To this division are attached on the under surface two filiform parts, consisting of 7—11 joints, which in some species occur only in the female and serve for the attachment of the eggs. In some species in front of these are two pairs of other parts at the base of the conical sucker, of which the first pair, shorter and broader, mostly forms a shear-shaped nipper, the second is filiform, and consists of five, sometimes of more joints, and is commonly denoted as a feeler (*palpus*). It is worthy of remark that the first-named, the nippers or *mandibulæ*, occur also in the earlier imperfect state of those species which, in the perfect form, are not provided with them.

The hardness of the integument of these animals renders it less probable that they breathe by the skin. Probably they have an intestinal respiration, such as occurs also in other animals.

Compare M. T. BRUENNICH *Entomologia*, Haffniæ, 1764, 8vo. p. 84, with the explanation of fig. 4 (*Pycnogonum*) of Tab.; various figures are found in MUELLER *Zool. danica* Tab. 119, in LEACH *Zoolog. Miscellany*, I. Pl. 13, 19, SAVIGNY *Mém. s. l. Ani. s. v.* I. p. 54, Pl. V. fig. 3, GUÉRIN *Iconogr., Arachn.* Pl. 4, &c.

G. JOHNSTON *Mag. of Zool. and Botany*, I. 1837; A. PHILIPPI *Neapolitanische Pycnogoniden* in ERICHSON'S *Archiv f. Naturgesch.* IX. 1843, s. 175—182, Tab. IX. figs. 1—3; H. KROEYER *Naturhist. Tidsskrift*, III. 1840, pp. 299—306, Tab. III. and ibid. new series, I. 1844, pp. 90—139; H. D. GOODSIR *On the specific and generic characters of the araneiform Crustacea, Ann. of nat. Hist.* XIV. pp. 1—4, Pl. 1; DE QUATREFAGES *Mém. sur l'organisat. des Pycnogonides, Ann. des Sc. nat.* 3e Série, Tom. IV. 1845, *Zool.* pp. 69—83, Pl I. II; DUJARDIN in *Compt. rend.* 1849. T. XXIX. p. 28; ZENCKER in MUELLER'S *Archiv f. Anat. u. Phys.* 1852, s. 379.

A. Mandibles and palps (first pair of maxillæ according to KROEYER) none. Accessory feet (second pair of maxillæ KROEY.) in females alone.

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[1] FABRICIUS considered the parasitic crustacean, named by LINNÆUS *Oniscus Cetr*, to be a species of this genus *Pycnogonum*.

*Pycnogonum* BRUENN. Body depressed. Feet not longer than body, thick.

Sp. *Pycnogonum littorale, Phalangium balænarum* L., BASTER *Nat. Uitsp.* II. Tab. XII. fig. 3, A—D, PALLAS *Misc. Zool.* Tab. XIV. figs. 21—23, GUÉRIN *Iconogr., Arachn.* Pl. 4, fig. 1; this animal, with other marine productions, is often cast upon our beach dead. The pair of feet that the female possesses above the male was already noted by BASTER as a sexual difference.

*Proxichilus* LATR. (in part), EDW. Body linear, feet slender, very long.

Sp. *Proxichilus spinosus* MONT., CUVIER *R. Ani. éd. ill., Arachn.* Pl. 21, fig. 2.

B. Two mandibles chelate, palps none.

*Phoxichilidium* EDW., KROEYER (*Orithyia* JOHNST.) Accessory feet proper to females alone, without claws.

Sp. *Phoxichilidium femoratum, Nymphon femoratum*, J. RATHKE *Skrivter af. naturh. Selskabet*, V. 1. Kiöbenhavn, 1799, p. 201, Pl. V. fig. H.

*Pallene* JOHNST., KROEYER. Accessory feet in both sexes terminated by a claw.

Sp. *Pallene spinipes, Pycnogonum spinipes* OTH. FABR., *Fauna Groenl.* p. 232.

C. Two mandibles; two palps. Accessory feet, oviferous in both sexes.

*Zetes* KROEYER. Rostrum very large, biarticulate. Feet scarcely longer than body. Mandibles filiform, short, not chelate.

Sp. *Zetes hispidus* KROEYER.

*Parıbœa* PHILIPPI.

*Nymphon* FABR. Rostrum uniarticulate, elongate. Mandibles chelate. Feet very long (surpassing the length of animal three times or more).

Sp. *Nymphon grossipes, Pycnog. grossipes* O. FABR. (in part), GUÉRIN *Iconogr., Arachn.* Pl. 4, fig. 3.

*Ammothea* LEACH.

Sp. *Amm. carolinensis* LEACH l. l. Tab. 13, *Encyclop. méth. Crust. et Ins.* Pl. 327, fig. 6.

D. Mandibles none, two palps.

*Endeis* PHILIPPI.

## ORDER II. *Colopoda.*

Feet very short, truncated, conical, indistinctly triarticulate, armed with four little claws or three, posterior placed at the extremity of body. Abdomen not distinct from trunk. Two oculiform points in most. Mouth with two styles exsertile, calcareous. (Androgynous animals).

### Family II. *Arctisca.* (Characters of the order.)

Here belong some small (microscopic) animals which live in mosses, in canals and sluices amongst confervæ, and in rain-water in spouts. We alluded to them above (p. 206) in passing, and cited them when treating of the wheel-animalcule, with which they agree in the property of reviving after long apparent death.

Compare J. E. EICHHORN *Wasserthiere*, Dantzig, 1775; *neue Auflage, unt. d. Titel: Beiträge zur Naturgesch. der kleinsten Wasserthiere*, Berlin, 1781, s. 74, Tab. VII. fig. E (*der Wasserbär*); SPALLANZANI, *Opuscules de Physique anim. et végét.* II. Genève 1777, II. pp. 349—352, Pl. IV. figs. 7, 8 (*le tardigrade*); J. A. E. GOEZE in his translation of BONNET *Abhandl. der Insektol. Anhang.* p. 367, Tab. 4, fig. 7 (according to his citation in the Journal: *Naturforscher*, XX. s. 114.)

O. F. MUELLER in FUESSLY, *Archives d'Entomol.* Tab. 36, p. 82, *Acarus ursellus.*

FR. VON PAULA SCHRANK, *Fauna Boica*, III. Bd., 1803, s. 178, *Arctiscon*, s. 195, *Arctiscon tardigradum.*

C. A. S. SCHULTZE, *Macrobiotus Hufelandii*, cum tab. lith. Berolini, 1834, 4to. ejusd. *Echiniscus Bellarmanni*, cum tab. lith. Berolini, 1840, 4to.

DOYÈRE *Mémoire sur les Tardigrades, Ann. des Sc. nat.*, 2e Série, Tom. XIV. *Zoologie*, 1840, pp. 269—361, Pl. 12—18, XVII. pp. 193—205, XVIII. pp. 1—35.

*Echiniscus* SCHULTZE, *Emidium* DOYÈRE.

*Milnesium* DOYÈRE.

*Note.*—DOYÈRE devised the generic name in honour of MILNE EDWARDS. Here belongs the animalcule described by SPALLANZANI under the name of *Tardigradus*, and perhaps *Arctiscon* SCHRANKII.

*Macrobiotus* SCHULTZE.

Sp. *Acarus ursellus* O. F. MUELLER, &c.

(The affinity with the *Acari* was already rightly perceived by the sagacity of the famous MUELLER, the most distinguished by far of all the investigators of microscopic animalcules previous to EHRENBERG.)

*Note.*—Genus *Myzostoma* LEUCK., containing species that live parasitically in *Comatulæ*, allied, according to JOH. MUELLER, to the *Arctisci*, ought perhaps to be placed amongst the parasitic *crustacea*. See below.

Section II. *Holothoraca.* Cephalothorax undivided. Organs of respiration in most internal, distinct, with two or more stigmata in abdomen, serving for the inspiration of air.

A. Tracheæ the sole instruments of respiration.

## ORDER III. *Acarina.*

Cephalothorax conjoined with abdomen not divided into segments. Mouth in many in the form of a rostellum.

Family III. *Acarea.* Head terminated anteriorly by labium emarginate, or by a single bifid process. Palps connate with labium, little distinct. Mandibles chelate. Ocelli none distinct. Feet mostly terminated by an adhesive vesicle or acetabulum and claws.

Compare on this family and the whole order A. DUGÈS *Recherches sur l'Ordre des Acariens, Ann. des Sc. nat.*, sec. Série, I. *Zool.* pp. 1—40, pp. 144—174; II. pp. 19—63; which author we shall principally follow here, for want of observations of our own; also DUJARDIN *sur les Acariens*, in *Comptes rend.* T. XIX. p. 1158, and *Ann. des Sc. nat.* 1845, sec. Série, Tom. III. p. 5; NICOLET *Hist. nat. des Acariens qui se trouvent aux environs de Paris, Archives du Mus.* T. VII. 1855, pp. 381—482.

*Acarus* LATR. *Tyroglyphus* (LATR. formerly), GERV. Body divided by a transverse furrow between the second and third pairs of feet. Four feet approximate at the insertion.

Sp. *Acarus domesticus* DE GEER, *Acarus siro* L. (in part), HERING, DE GEER, *Mém.* VII. Pl. 5, figs. 1—11, LYONET *Recherches*, Pl. 14, fig. 15, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 52, figs. 4—7 (under the wrong name of *sarcopte de la gale*;) this small mite, living on old cheese, has in the young state, like many *Acarida*, only six feet.

*Myobia* V. HEYDEN.

Sp. *Sarcoptes musculinus* KOCH, HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 138, Tab. 13.

*Hypopus* DUGÈS.

See DUJARDIN, *Mém. s. des Acariens sans bouche dont on a fait le genre Hypopus, et qui sont le premier âge des Gamases*, in *Ann. des Sc. nat.*, 3e Série, *Zool.* Tom. XII. 1849, pp. 245, 250.

*Sarcoptes* LATR. Body not furrowed between the second and third pairs of feet. Third pair of feet remote by a large interval from the four anterior feet.

*Note.*—Here are to be referred genera *Trichodactylus* DUFOUR and *Glyeyphagus* HERING.

Comp. E. HERING, *Die Kräzmilben der Thiere* (1835), *Nov. Act. Acad. Leop. Carol. Nat. Curios.* Vol. XVIII. 2, p. 573—624, Tab. 43—45.

Sp. *Sarcoptes scabiei, Acarus siro scabiei* L., BONONNI *Observationes circa viventia* &c. Romæ, 1691, fig. 113—DE GEER *Mém.* VII. Pl. 5, figs. 12, 13; DUGÈS *Ann. des Sc. nat.* 2e Série, III. Pl. XI. B; GUÉRIN *Iconogr., Arachn.* Pl. 5, fig. 12; SCHMIDT'S *Jahrbucher f. Med.* 1852, Bd. 76. s. 204. This species, which has been very incorrectly confounded with the cheese-mite, digs into the human skin[1], and causes the itch. Other species occur in animals. Here belongs, for instance, *Sarcoptes equi* (commonly regarded as the *Acarus exulcerans* L.) HERING l. l. Tab. 43, figs. 1, 2, DUJARDIN *Observ. au microscope*, Pl. 16.

See on this subject the interesting *Medeelingen van* Dr D. H. VON LEEUWEN in the *Nederl. Lancet* 1846, and his treatise *Over de Schurft der Dieren* in A. NUMAN'S *Vee-artsenijkundig Magazijn*, VI. 1847, blz. 52—159, met 2 pl. HESSLING in the *Münchener medicinishen Zeitung* 1852, Bd. 76, has described some new parasitic mites in *plica polonica* of the human subject.

*Note.*—In this family is commonly enumerated an elongate animalcule found within a few years by SIMON in the sebaceous follicles of the skin of the face, which scarcely has its place here. In the short, conical feet, it agrees with the *Arctisca* s. *Colopoda*.

Compare G. SIMON, *Ueber eine in den kranken u. normalen Haar-säcke des Menschen lebende Milbe*, MUELLER'S *Archiv f. Anat. u. Physiol.* 1842, s. 218—237, Tab. XI.

*Demodex follicudorum*, OWEN'S *Lectures on the comp. Anatomy of the invert. Animals*, pp. 251, 252, 2nd ed. p. 444, 445. The same, or a nearly allied species, was found in the pustules of a mangy dog in numbers, by Mr TOPPING, OWEN, p. 445.

*Dermaleichus* KOCH.

Consult *Uebersicht der Arachniden-Systems*, IIItes Heft 3, 1843, pp. 122—126.

Family IV. *Notaspidea*. Body defended by a horny, hard covering. Mandibles chelate. Palps fusiform, quinquearticulate.

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[1] That this animalcule resides here, and not in the pustules, was already expressly announced by NYANDER, LINN. *Amoenitat. Acad.* V. p. 95.

Feet gressorial, with coxæ scarcely distant, unguiculate, not provided with a vesicle or acetabulum.

*Oribata* LATR. (*Notaspis* HERMANN).

Sub-genera: *Hopophora* KOCH, *Galumna* V. HEYDEN, GERV. (*Pelops* KOCH, *Oribates* and *Zetes* ejusd.), *Damæus* KOCH, (*Belba* V. HEYDEN), *Nothrus* KOCH.

Consult OLIVIER *Encycl. méthod., Ins.* VIII. pp. 530—534. Most of the species live in mosses on the trunks of trees; in some the body is girdled by a lamella produced on each side; *Acarus marginatus* DE GEER *Mém.* VII. Pl. VIII. fig. 6, *Notasp. humeralis* HERM. *Mém. Apt.* Pl. 4, fig. 5;—*—Notasp. alatus* HERM. Pl. 4, fig. 6, &c.

Family V. *Ixodea.* Body defended by a coriaceous, extensile covering. Palps sheathing rostrum, with four joints; rostrum porrect, truncated, composed of two lateral parts (mandibles?), denticulate at the apex, and a middle part (labium) covered with numerous recurved barbs. Feet with last joint armed with a caruncle or vesicle, and with two claws.

*Ixodes* LATR.

Sp. *Ixodes ricinus, Acarus ricinus* L., DE GEER *Mém.* VII. Pl. 6, figs. 1—8, LYONET *Recherch.* Pl. 6, figs. 1—8, *Tick, Louvette;* these animals live in woods, and attach themselves (the female) to different animals, especially to dogs; from sucking the blood the body swells in form of a pea. The female is nearly 5‴ long; the male, much smaller, on copulating attaches itself beneath the abdomen of the female by means of the sucker, at the base of which the *vasa deferentia* open, to the *vulva,* situated at the forepart of the body between the first and second pairs of feet. This singular copulation was already figured by DE GEER; see also P. W. J. MUELLER in GERMAR u. ZINCKEN *Magaz. der Entomol.* II. 1817, s. 278—289. When laying her eggs, the female, according to the observations of FRISCH, gives out a clear fluid from her mouth, for fixing to her body the eggs, which the animal advances to her mouth; hence the erroneous opinion of CHABRIER that the eggs are laid through the mouth.

*Ixodes americanus, Acarus nigua* DE GEER *Mém.* VII. Pl. 37, figs. 11—13. Compare G. R. TREVIRANUS, *Zeitschr. f. Physiol.* IV. 11. s. 185—191, Taf. XV. XVI. (probably *Ixodes crenatus* KOLLAR). This and other allied species known in America by the name of *Piques* are very distressing, and sometimes dangerous to man and cattle.

By the presence or absence of eyes (which are wanting in *Ixodes ricinus*), and some other characters, KOCH has divided this numerous genus into several others. See ERICHSON'S *Archiv f. Naturgesch.* 1844, s. 217—239, and *Uebersicht,* 4tes Heft, 1847.

Family VI. *Gamasea.* Palps free, filiform. Mandibles chelate, didactylous. Feet terminated by two claws and a caruncle or vesicle. Ocelli none, or indistinct. (Animalcules mostly parasitic).

This family unites some characters of the third family with others of the fifth. The larvæ, or the imperfect young animals, have only six feet. Here belongs the genus *Caris* of LATREILLE, which contains mites that live on bats, probably young individuals of *Dermanyssus*.

*Uropoda* LATR. Body depressed, with dorsal shield orbicular. Peduncle deciduous, infundibuliform at the posterior part, serving for fixing the body.

Sp. *Uropoda vegetans, Mitte végétative* DE GEER *Mém.* VII. Pl. 7, figs. 15—19; KOCH in HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 188, Tab. 19; GUÉRIN *Iconogr., Arachn.* Pl. V. fig. 10; parasitic on beetles. GERVAIS mentions some other species, *Aptères*, III. p. 221.

*Pteroptus* LÉON-DUFOUR, *Celeripes* MONTAGU, *Spinturnia* V. HEYDEN. Body depressed. Palps with last joint longer, oval. Feet thick, with joints short.

Sp. *Pteroptus vespertilionis*, HERMANN *Mém. Aptér.* Pl. 1, fig. 14, KOCH in HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 167, Tab. 23, parasitic on *Vespertilio noctula;* the same or a nearly allied species occurs on *Vesp. serotinus.* See on other species KOCH l. l. Heft 137 and 188, who joins this and the preceding genus to the *Sarcoptides* (our *Acarea*).

*Argas* LATR. Rostrum inferior, concealed under the margin of body produced. First joint of palps longer than the rest. Feet approximate at the insertion, biunguiculate, with caruncle none or indistinct.

Sp. *Argas reflexus* LATREILLE, *Argus reflexus* FABR., *Rhynchoprion columbæ* HERM. *Mém. Apt.* Pl. 4, figs. 10, 11, KOCH in HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 189, Tab. 1; found in France, Italy, &c. on pigeons. A species occurring in Persia, lives in houses, and by its puncture occasions in man convulsions, delirium, and sometimes, as is asserted, even death: *Argus persicus* FISCHER, GERVAIS *Aptères*, III. pp. 229—231, Pl. 33, fig. 6.

*Holothyrus* GERV.

Consult GERVAIS *Aptères*, III. pp. 233. Is this its place?

*Dermanyssus* DUGÈS. Last joint of palps very small; labium acute; mandibles in males chelate, with outer finger very long, in females ensiform. Body soft. Anterior feet elongate; last joint of feet furnished with caruncle bilobed and two claws.

Sp. *Dermanyssus avium* Dug s, Gerv., (*Smaridie des petits oiseaux*) Duméril *Cons. gén. s. l. Ins.* Pl. 52, fig. 1, Lyonet *Recherch.* Pl. 5, fig. 11, Dugès *Ann. des Sc. nat.* 2e Série, *Zool.* Tom. II. Pl. 7, fig. 1; Dugès and Koch unite with this species the *Acarus Gallinæ* De Geer *Mém.* VII. Pl. 6, figs. 13, 14, and *Acarus hirundinis* Hermann, Pl. 1, fig. 13. This species lives in bird-cages and hen-houses, and sucks the blood of the animals, especially by night. Other species live on different birds, on bats, &c.

*Gamasus* Latr. (with the addition of genera *Siro* and *Macrocheles* ejusd.). Mandibles chelate, denticulate. Labium trifid. Body with dorsal shield coriaceous, mostly double. Anterior feet mostly longer; second pair of feet in some incrassated.

Sp. *Gamasus coleoptratorum, Acarus coleoptratorum* L., Roesel *Ins.* IV. Tab. 1, figs. 10—13, De Geer *Mém.* VII. Pl. 6, fig. 15, Koch in Herrich-Schæffer *Deutschl. Ins.* Heft 168, Tab. 19; the *beetle-mite:* the body has an orange-yellow or blood-red colour; many insects, that creep underground, or live in dung, especially beetles (*Geotrupes vernalis, stercorarius*) have sometimes their entire body covered with hundreds of these mites.

This numerous genus contains moreover many species that live on the ground, in mosses, underwood, and moist pastures. Also the mite which was met with by Lyonet on the caterpillar of *Cossus ligniperda* belongs here. *Rech.* Pl. 6, figs. 11, 12.

Sub-genus: *Lælaps, Zercon, Sejus* Koch.

Consult *Uebersicht des Arachnidensystems*, 3tes Heft, 3e Abtheil. 1843.

Family VII. *Hydrarachnidia.* Palps with last joint unguiculate or spinose. Eyes two or four, distinct. Feet with broad coxæ, mostly ciliated, natatory, posterior surpassing the rest in length. Aquatic animals.

Compare *Hydrachnæ, quas in aquis Daniæ palustribus detexit, descripsit, pingi et tabulis* XI. *æneis incudi curavit* O. F. Mueller, Lipsiæ, 1781, 4to.

The distinction of these water-spiders as a peculiar genus is to be ascribed to O. F. Mueller. Linnæus had not received these animals into his *Systema naturæ;* Fabricius in his *Entomologia systematica,* united the species then known to him with his genus *Trombidium,* and only afterwards, in his *Systema antliatorum,* made room for a distinct genus for these species under the name of *Atax,* p. 366. Besides the genus *Hydrachna* of Mueller we also receive into this family a species of *Acarus* of Linnæus, which is the *typus* of the genus *Limnochares* of Latreille.

*Limnochares* Latr. Palps scarcely longer than rostrum. Rostrum conical, truncated; mandibles indistinct, with last joint subulate. Ocelli four. Legs pilose, four posterior remote.

Sp. *Limnochares holosericea*, *Acarus aquaticus* L. (excl. citatione FRISCHII et SULZERI), RŒSEL *Ins.* III. Tab. 25, DE GEER *Mém.* VII. Pl. 9, figs. 15—17, KOCH in HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 150, Tab. 24; 2‴ or 3‴ long, elongate, very soft, during life vermilion-red: this little animal creeps on the bottom of morasses and ditches, and upon water-plants. The young animals have six feet, and attach themselves by their sucker to *Gerris lacustris* (p. 443) DUGÈS *Ann. des Sc. nat.*, sec. Série, I. p. 161.

*Eylais* LATR. Palps with basal joints short, penultimate large, last subulate, armed with spines. Rostrum short. Mandibles terminated by a moveable claw. Ocelli four, approximate in the middle of the anterior part of body. Feet long, slender; two posterior pilose, the rest ciliated.

Sp. *Eylais extendens*, *Hydrachna extendens*, MUELL., *Hydr.* Tab. 9, fig. 4, KOCH l. l. Tab. 21, 22 (according to KOCH *Acarus aquaticus* L., which however is doubtful, and is in opposition to the citation of RŒSEL from LINNÆUS).

*Hydrachna* MUELL. (in part), LATR., DUGÈS (and *Diplodontus* ejusd.). Penultimate joint of palps forming with the last a forceps. Ocelli two, or four bigeminous, lateral, distant. Feet ciliated.

Sp. *Hydrachna cruenta* MUELL., *Hydryphantes cruentus* KOCH, DE GEER *Mém.* VII. Pl. 9, figs. 11, 12, MUELLER *Hydr.* Pl. 9, fig. 1, KOCH in HERRICH-SCHÆFFER *D. Ins.* Heft 150, Tab. 16. The young animals of this and other species with six feet and a sucker, as MUELLER had already remarked (*pullos ex ovis excludi sex tantum pedibus et proboscide singulari instructos*), are described as distinct species of *Acarida* by AUDOUIN, under the generic name *Achlysia* (*Mém. de la Soc. d'Hist. nat. de Paris*, I. 1823, pp. 98—109). DUGÈS has illustrated this subject by continuous observations, and has made known the entire life of these water-spiders in its different periods, *Ann. des Sc. nat.* 2e Série, I. pp. 165—171. From the eggs, which have been laid in spring in the stems of water-plants perforated for the purpose, little hexapod animals come to view, with a large heart-shaped sucker, which might be taken for a head, but that the eyes are situated behind it, on the anterior margin of the back. After an interval they attach themselves to different water-insects (*Nepa*, *Ranatra*, *Dytiscus*), and, whilst the abdomen is growing and extending itself into an elongated sac, the feet and the sucker remain of the same size. In this form the water-spiders were observed by SWAMMERDAM on *Nepa* (*Bijbel der Natuur.* Pl. III. figs. IV. and V.), and described by him as the eggs of this animal, although he had already expressed his doubts whether they were not rather distinct animals, which had their increase by sucking the blood of the *Nepa* (blz. 230). In this period the animalcules are named *Achlysia* by AUDOUIN; DUGÈS then calls them nymphs; within the skin the perfect animal is formed, like a fly in the *pupa coarctata* (see above, p. 273). BURMEISTER also, simultaneously with DUGÈS, announced from his observations that *Achlysia* is a youthful form of *Hydrachna*. OKEN'S *Isis*, 1834, s. 138—142.

*Atax* FABR. (in part), DUGÈS (and *Arrenurus* ejusd.), Palps subulate, with last joint falcate, or unguiculate. Ocelli two, lateral, distant. Body in the males of some species narrowed posteriorly and produced into an appendage truncated or cylindrical (*Arrenurus* DUGÈS).

Add sub-genera: *Nesæa, Piona, Hygrobates*[1], *Hydrochoreutes, Atractides, Acercus, Marica* KOCH.

Comp. *Uebersicht des Arachnidensystems,* IIItes Heft, erst Abtheil. 1842, and P. T. VAN BENEDEN *Recherches sur l'Atax ypsilophora, Hydrachna concharum. Mém. de l'Acad. royale de Belgique,* Tom. XXIV.

Family VIII. *Bdellea.* Rostrum subulate, separated from body by stricture, often large, resembling a head. Body oblong, mostly parted by a transverse groove or stricture between the second and third pairs of feet. Palps inserted at the base of rostrum, lateral, divaricate, large. Mandibles terminated by an incurved claw or two small fingers. Ocelli mostly distinct, four. Feet cursorial, attenuated towards the apex, terminated by two small claws.

*Bdella* LATR., *Scirus* HERM. Palps filiform, geniculate or incurved. Feet subequal.

*Bdella* DUGÈS, KOCH, *Ammonia* KOCH, *Scirus* DUGÈS, KOCH, *Eupalus* KOCH.

Comp. *Uebersicht des Arachnidensystems,* IIItes Heft, 3, pp. 73—80.—Sp. *Bdella vulgaris* LATR., HERMANN *Mém. Aptér.* Pl. 3, fig. 9, KOCH, HERRICH-SCHÆFFER *D. Ins.* Heft 167, tab. 8.

*Cheyletus* LATR. Palps thick, incurved, filiform. Feet slender, anterior longer. Ocelli none or indistinct.

See figures in KOCH, HERRICH-SCHÆFFER, Heft. 167, Tab. 20, 21, 22.

Family IX. *Trombidina.* Palps chelate, with last two joints opposite, the external (penultimate) representing an incurved claw. Feet terminated by two small claws, cursorial.

*Trombidium* FABR. (exclusive of some species). Two mandibles horny, unguiculate, included in labium. Body suboval or

[1] In the neighbourhood of *Hydrobates* KOCH probably *Pontarachna* PHILIPPI ought to be placed, if it is to be considered a distinct genus; a very small *Hydrachna* observed in the bay of Naples. *Annals of nat. History,* VI. 1841, pp. 98—100.

oblong, divided into two parts; two anterior pairs of feet placed at the anterior part, remote from the two posterior. Ocelli two, subpedunculate.

Sp. *Trombidium holosericeum* FABR., *Acarus holosericeus* L., DE GEER *Mém.* VII. Pl. 8, figs. 12—18, HERMANN *Mém. Aptèr.* Pl. I. fig. 2, and Pl. II. fig. 1, TREVIRANUS *Verm. Schr.* I. Tab. V. fig. 28; scarlet-red, felty, almost quadrangular: this little animal may be often seen, especially in spring, on the ground in gardens or in mosses on the stems of trees.

*Trombidium tinctorium* FABR., SLABBER *Natuurk. Verlustig.* Tab. II., HERMANN *Mém. Aptérol.* Pl. I. fig. 1, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 55, fig. 4, from Guinea.

The young individuals of different species live parasitically on insects. These are the six-footed Acarida, of which LATREILLE formed the genus *Astoma* (*Gen. Crust. et Ins.* I. p. 162). On *Phalangium* also such hexapod parasites are met with (Genus *Leptus* LATR. l. l. p. 161).

*Stigmæus* KOCH. With ocelli indistinct.

*Erythræus* LATR. (*Rhyncholophus* DUGÈS, KOCH; *Erythræus* DUGÈS, KOCH).

*Note.*—Body undivided. Four posterior feet not very remote from anterior. Other characters almost of *Trombidium*.

On some other divisions see KOCH *Uebersicht*, III. 2, pp. 41—60. Here also is to be referred genus *Tetranchus* DUFOUR (*Ann. des Sc. nat.* XXV. 1832, pp. 276—283), to which division belong *Trombidium telarium*, *T. tiliarum*, *T. Socium* HERM., and other minute species of Acari, forming fine close webs that invest and suffocate shrubs and trees.

## ORDER IV. *Phalangita.*

Cephalothorax conjoined with abdomen. Abdomen ringed or transversely folded. Palps filiform.

Family X. *Phalangita.* (Characters of the order those of the single family). Mandibles didactylous, mostly exsert. Feet elongate, terminated by a single claw.

*Trogulus* LATR. Cephalothorax produced anteriorly into a clypeus, covering the organs of the mouth. Ocelli two at the base of clypeus. Palps filiform, not unguiculate at the apex. Tarsi not elongate, with three joints. Body elongate, depressed.

Sp. *Trogulus nepæformis* LATR., *Gener. Crust. et Ins.* Tab. VI. fig. 1, GUÉRIN *Iconogr., Ins.* Pl. 4, fig. 6. To this genus belongs also *Phalangium tricarinatum* L. and FABR., but is, according to KOCH, a different species from

the former: see other species of this genus figured and described in KOCH's *Arachn.* v. Bd. pp. 128—149. Tab. 176—179.

*Cryptostemma* GUÉR. With ocelli none or indistinct; with tarsi composed of four or five joints; with mandibles exsert. See GUÉRIN *Revue Zool.* 1838, p. 11, GERVAIS *Aptères*, III. pp. 130, 131, Pl. 47, fig. 4.

*Note.*—Genus *Cœculus* LÉON DUFOUR *Ann. des Sc. nat.* XXV. 1832, pp. 289—296, Pl. 9, figs. 1—3, is referred here by its author himself, by GUÉRIN and others; but this scarcely seems to be its place.

*Phalangium* LATR. (species from genus *Phalangium* L.). Cephalothorax not produced anteriorly. Mandibles exsert. Palps unguiculate at the apex. Tarsi mostly with several (6—8, or very numerous) joints. Ocelli two in the middle of cephalothorax, seated on a common tubercle; two others accessory in many, lateral, remote, situated more forward.

*Gonyleptes* KIRBY. Palps spinose, dilated. Coxæ of last pair of feet very broad. Dorsal scutum horny, hard. (Tarsi mostly with not more than ten joints. Posterior feet longer than the rest),

Sp. *Gonyleptes horridus* KIRBY *Transact. Linn. Soc.* XII. Pl. 22, fig. 6, *Centurie d'Ins.* Paris, 1834, Pl. 4, fig. 8, Brazil;—*Gonyl. curvipes* GUÉRIN *Iconogr., Arachn.* Pl. 4, fig. 5, Chili, &c.

*Note.*—All the species are exotic; in some the posterior legs are very long, slender, and surpass the body three times or more: *Mastigopus* (genus ineditum Musei L. B.) or *Mitobates* SUNDEV. *Conspect. Arachn.* p. 34. PERTY and KOCH have proposed several other genera, on which see KOCH *Uebersicht*, 2 Heft, pp. 8—22. Genera *Cosmetus* and *Discosoma* PERTY form the transition between *Gonyleptes* and *Phalangium*.

*Phalangium* (species from genus *Phalangium* auctor). Posterior coxæ scarcely thicker than the rest. Feet slender, with tarsi having numerous joints (10—15 or more); second and last pairs subequal, longer than the others.

Sp. *Phalangium opilio* L., *Opilio parietinus* HERBST, KOCH, DE GEER *Mém.* VII. Pl. 10, fig. 1, HAHN *Arachnid.* II. Pl. 69;—*Phal. cornutum* L., *Cerastoma cornutum* KOCH, DE GEER ib. fig. 12, HAHN *Arachn.* II. Pl. 70, HERMANN *Mém. Aptér.* Pl. 8, fig. 6 (GEOFFROY and LATREILLE hold the two for one species, and the last for the male of *Opilio;* HERMANN, TREVIRANUS, HAHN and KOCH consider them to be different species. These animals (*harvest-spiders, basterd-spinnen hooiwagens, faucheurs*) run very rapidly; they lurk in chinks of walls, live on the ground between stones, on trunks of trees, &c. The long thin legs, after their separation from the body, present for a long time indications of remaining irritability. The

anatomy of *Phalangium Opilio* has been described by G. R. TREVIRANUS *Verm. Schr.* I. 1816, s. 20—40, and A. TULK *Ann. and Magaz. of nat Hist.* Vol. XII. 1843, pp. 153—165, pp. 243—253, pp. 318—331, Pl. 3—5.

*Note.*—Several genera have been proposed by KOCH for the arrangement of the numerous species of *Phalangium;* see *Uebersicht,* 2tes Heft, s. 23—38.—*Phalangodes* TELLKAMPF is distinguished by the defect of ocelli.

## ORDER V. *Pseudoscorpiones.*

Cephalothorax conjoined with abdomen. Abdomen annulate. Palps large, terminated by a hand didactylous (chela).

Family XI. *Pseudoscorpiones.* (Characters of the order those of the single family). Palps longer than feet, thicker. Feet moderate, terminated by two claws. Habitus of little scorpions without tails.

*Chelifer* GEOFFR., LATR. (*Obisium* ILLIG.), species of *Phalangium* L. The single genus. (Mandibles didactylous. Ocelli two or four, distant, lateral).

*Chelifer* LEACH. Cephalothorax parted in two by a transverse furrow. Ocellus single on each side.

Sp. *Chelifer cancroïdes, Phalangium cancroïdes* L., RŒSEL *Ins.* III. Tab. 64; the book-scorpion; brown red; the shear-shaped palps are twice as long as the body; the body without the palp is scarcely 1‴ long. This little animal lives in dark and moist places in houses, between books, &c., and feeds on mites and wood-lice.

*Obisium* LEACH. Cephalothorax undivided. Ocelli on each side two.

Comp. LEACH *Transact. of the Linn. Soc.* XI. p. 391; LEACH *On the Characters of Scorpionidea, with descriptions of the British Species of Chelifer and Obisium, Zool. Miscell.* III. 1817, Pl. 48—53; DE THEIS *Lettre à M.* AUDOUIN *sur quelques Arachnides, Ann. des Sc. nat.* XXVII. 1832, pp. 61—78, Pl. 1—3; KOCH *Arachnid.* X. Bd. 3, 4 Heft (new genera *Chthonius* and *Pelorus*).

## ORDER VI. *Solifugæ.*

Cephalothorax distinct from abdomen. Abdomen annulate. Palps filiform, porrect, of the length of feet.

Family XII. *Galeodea.* (Characters of the order those of the single family).

*Galeodes* OLIV., LATR. (*Solpuga* LICHTENST., FABR.). Mandibles ventricose, large, porrect, with chelæ vertical, the lower finger moveable. Palps with apex rounded, clawless, longer than the first pair of feet. First pair of feet unarmed, remaining feet armed with two claws at the apex. Ocelli two, placed in a common tubercle at the middle of the thoracic shield, near the anterior margin. Body villose; legs and palps covered with long scattered hairs. Posterior coxæ furnished at the inferior margin with a row of appendages membranous, triangular, petiolate.

Sp. *Galeodes araneoïdes, Phalangium araneoïdes* PALL. *Spicil.* IX. Tab. III. figs. 7, 8, 9, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 55, fig. 3, Southern Russia, Greece, &c., and many other species, especially from Africa. See KOCH in ERICHSON'S *Arch. f. Naturgesch.* VIII. 1842, s. 350—356. Most of the species are from the old world; there are, however, American species also enumerated by KOCH, to which may be added *Galeodes limbata* and *G. Cubæ*, LUCAS in GUÉRIN *Mag. de Zool.* 1834, *Arachn.* Pl. 5, 1835, *Arachn.* Pl. II. These animals appear to reside in warm sandy regions, and to come from their lurking-places by night especially. On the dorsal surface of the upper-jaws some have a leaf-like appendage, which, according to GERVAIS, is a character of the male.

According to J. MUELLER, besides the two larger eyes, there are in an Egyptian species two smaller eyes on pedicles, and two lateral eyes (*Vergl. Physiol. des Gesichtsinnes*, s. 322); in the specimens investigated by me I could not perceive these eyes.

The bite of *Galeodes* is considered to be very venomous and dangerous; OLIVIER, who met with many of these animals in Persia and Arabia, was not himself bitten, nor was any one of his companions, by them, and was not able to discover any sure proof of the reality of the danger. *Voyage dans l'Empire othoman*, Paris, Tom. VI. 1807, p. 306. (Comp. also the figures there, Pl. 42, figs. 3—6, and in SONNINI *Voyage en Grèce*, Paris, 1801, Pl. 3; the latter traveller found his specimen on the island of Cyprus. See I. pp. 115—124.)

Sub-genera: *Solpuga, Galeodes, Aellopus* KOCH (with jointed tarsi), *Rhax, Gluvia* ejusd. (with tarsi not jointed).

B. Respiratory organs either lungs or tracheæ, together with lungs. Cephalothorax distinct from abdomen.

## ORDER VII. *Pedipalpi.*

Palps large, resembling feet, chelate at the apex. Abdomen divided by segments. Pulmonary sacs without tracheæ; eight or four stigmata.

Family XIII. *Phrynides.* Abdomen separated from thorax by a slight constriction. Stigmata two on each side at the base of

abdomen. Mandibles monodactylous. Palps spinose. Ocelli eight, situated at the anterior part of cephalothorax; the two middle approximate on a common tubercle; three on each side marginal, disposed in a triangle. Two anterior feet longer, with tarsi clawless, slender, multiarticulate.

*Phrynus* OLIV. (Species of *Phalangium* L., *Tarantula* FABR. in part). Palps supplied at the apex with a horny claw, of the length of body or longer than body. First pair of feet slender, very long, resembling antennæ, with tibiæ and tarsi multiarticulate. Body depressed. Cephalothorax broad, semicircular, emarginate posteriorly.

Sp. *Phrynus lunatus, Phalangium lunatum* PALL., *Phalangium reniforme* L. (in part), PALLAS *Spicil. Zool.* IX. Tab. 3, fig. 5, HERBST *Natursyst. der ungefl. Ins.* I. Berlin, 1797, Tab. III., LATR., *Hist. nat. des Crust. et des Ins.* Pl. 61, fig. 1;—*Phrynus reniformis, Phalangium reniforme* PALL. (not L.), *Spic. Zool.* Tab. cit. fig. 3, DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 56, fig. 2, &c.

Comp. J. VAN DER HOEVEN, *Bijdragen tot de kennis van het geslacht Phrynus, Tijdschr. voor nat. Geschied. en Physiol.* IX. pp. 68—91. Pl. I. II.

*Telyphonus* LATR. (Species of *Phalangium* L., *Tarantula* FABR. in part). Palps thick, terminated by hand didactylous, shorter than body. First pair of feet with tarsi eight-jointed, and tibia with two joints. Cephalothorax oblong, oval, not broader than abdomen. Abdomen terminated by an articulate seta.

Sp. *Telyphonus proscorpio* LATR., *Phalangium caudatum* L., *Spic. Zool.* IX. Tab. 3, figs. 1, 2, GUÉRIN *Iconogr., Arach.* Pl. 3, fig. 3 (is it the same species?); hab. in Java.

*Note.*—The species of this, as well as of the preceding genus, are difficult to distinguish. They are found in tropical regions of both hemispheres: none European is known. On the *Telephoni* comp. LUCAS in GUÉRIN *Magas. de Zool.* 1835. *Arachn.* Pl. 8—10.

Family XIV. *Scorpiones.* Abdomen sessile. Stigmata four on each side, in the second, third, fourth and fifth ventral scuta. Mandibles didactylous. Palps longer than feet, terminated by hand didactylous with external finger mobile. Six last segments of abdomen abruptly narrowed, resembling a tail; last segment vesicular, terminated by an incurved sting. Feet increasing in length from the first towards the last pair, moderate, all biunguiculate at the apex. Two pectinate appendages, with teeth different in number,

at the inferior part of body behind the coxa of the fourth pair of feet.

*Scorpio* L. (Characters of the family). Ocelli two in the middle of cephalothorax, approximate, larger. Lateral ocelli in the anterior margin of cephalothorax, number various.

The scorpions live in warm regions of the temperate zone and in tropical countries. In the last joint of the abdomen is a poison-gland, which renders the wound of the scorpion dangerous, (see REDI *De Generat. Insector.* Amstelod. 1686, pp. 84—91; DE MAUPERTUIS *Expériences sur les Scorpions, Mém. de l'Acad. de Paris, pour* 1731, p. 223). Moreover these animals are distinguished by two comb-shaped appendages at the base of the abdomen. These appendages consist of a flat pedicle that runs transversely outwards and becomes thinner towards its apex; this on its inferior margin bears parallel lancet-shaped leaflets (teeth), standing perpendicular to its axis. The number of these teeth differs in different species, yet is not sufficiently determinate but subject to change, so that it it is an uncertain character for the distinction of species.

Comp. on the divisions and the species of this numerous family, LEACH *Trans. of the Linn. Soc.* XI. p. 391; HEMPRICH and EHRENBERG *Symb. physic., Evertebr.* I. *Arachnoïdea,* Berolini, folio 1828, cum tabulis 2; P. GERVAIS *Remarques sur la famille des Scorpions, Archives du Muséum,* Tom. IV. 1845, pp. 201—240. Pl. XI. XII. On the number of the eyes alone no natural groups or sub-genera can be founded. The *habitus,* the greater or less breadth of the six last abdominal rings, and the form of the forceps, indicate better sub-divisions, or ought at least to be conjoined with the character from the eyes.

*Androctonus* EHRENB. With twelve ocelli, five lateral on each side. *Centrurus* EHRENB. With ten ocelli, four lateral on each side. *Buthus* LEACH, EHRENB. With eight ocelli, three lateral on each side. *Scorpio* LEACH, *Scorpius* EHRENB. With six ocelli, two lateral on each side.

*Note.*—Sub-genus *Buthus,* far from natural, ought to be distributed into other sub-genera, after the example of EHRENBERG and KOCH; comp. GERVAIS l. l., who admits three sub-genera *Ischnurus, Buthus* and *Telegonus.*

Sp. *Scorpio europœus, Scorpio flavicaudus,* DE GEER *Mém.* VII. Pl. 40, figs. 11—13, SCHÆFFER *Elem. Entom.* Tab. 113, CUV. *R. Anim. éd. ill., Arachn.* Pl. 19, fig. 2, hab. south of Europe and north of Africa;—*Scorpio afer* L., RŒSEL *Ins.* III. Tab. 65, KOCH *Arachniden,* III. Tab. 79, &c.

## Order VIII. *Araneidea.*

Palps subfiliform, with last joint in males supplied with various appendages, subservient to copulation. Abdomen covered with skin continuous, mostly soft, constricted at the base or joined to the cephalothorax by means of a petiole. Stigmata never more than four, mostly only two. Respiration in all pulmonary, in some tracheal at the same time.

Family XV. *Araneidea* (*Aranew* Latr.) Characters of the order also those of the single family.

(Mandibles monodactylous, with terminal claw perforate, for the excretion of a poisonous liquid. Four or six papillæ cylindrical or conical at the inferior surface of abdomen, situated towards the posterior part, perforated by very minute foramina for the passage of a silky substance. Feet different in length, similar in form, terminated by a double or triple claw.)

The *spiders*. All these animals prepare from a silky substance certain filaments with which they cover their eggs. Many, from the same substance, form also webs and nets in which they capture their prey. At the hind part of the body four, or in most species, six spinarets are found, beset with fine tubules through which the silky matter escapes. The secretion is effected in the form of an adhesive fluid by means of glands, or tubes of very different form, pear-shaped, glandular sacs united in groups, blind tubes convoluted and ramified. See Treviranus *Ueber den innern Bau der Arachnid.* s. 41—44, Tab. iv, v. figs. 42—44; *Verm. Schr.* i. s. 11, 12, Tab. i. fig. 4, H. Meckel *Arch. f. Anat. u. Physiol.* 1846, s. 50—56, Taf. iii. figs. 38—45.

The long threads that cover the fields or float in the air, especially in the fall of the year, (*Gossamer, Herfstdraden, fils de la Vierge, Herbstgarn, der fliegender Sommer*) are considered by some writers to be products of the atmosphere, or exhalations from plants; the chemical investigation of G. J. Mulder has proved that these threads agree in composition with silk, and beyond doubt are the work of spiders.

See *Natuur-en Scheikundig Archief*, and a postscript by my hand, in which I have cited some works on this subject. Latreille ascribes these

threads to young spiders. *Règne Anim.* 2 éd. IV. pp. 219, 220. Comp. J. BLACKWALL *Catalogue of British Spiders, including Remarks on their Structure, Functions, Economy and Systematic Arrangement, Ann. nat. Hist.* 2nd Series, VII.—IX. 1851—1853.

Phalanx I. *Arenecæ tetrapneumones, Mygalides* SUNDEV., KOCH. Spinarets four, two of them large, exsert, two others very short. (Stigmata four, leading to four pulmonary sacs. Ocelli always eight. Claw at the apex of mandible in the same direction as the mandible, capable of inflection downwards, large, incurved).

*Mygale* WALCK. Ocelli approximate, situated in the anterior part of cephalothorax ( ⁘ ). Palps proceeding from the apex of maxillæ. Labrum inserted under the base of maxillæ, very small, quadrate. Feet hirsute, subequal, first and fourth pairs longer.

Sp. *Mygale avicularia* WALCK., *Aranea avicularia* L., KLEEMANN *Beiträge*, Tab. XI. XII., DE GEER *Mém.* VII. Pl. 38, fig. 8; a large spider of S. America; the body 1″ 6‴ and more, the hind legs 2″ 3‴; it lives in a tubular web narrowed behind, in chinks of bark of trees, between stones, &c.; the female places the web in which she has laid her eggs close to her nest. It has been asserted that these spiders are able to seize small birds (humming-birds), and hence the name of this species; there is, however, no reason to think that the account is founded on any thing better than fable. See on the web and mode of life of this animal LATREILLE *Mém. du Mus.* VIII. 1832, pp. 456—460, and W. S. MAC LEAY *Trans. of the Zool. Soc.* I. 2, 1834, pp. 179—194. Other similarly large species are also found in the eastern hemisphere, as *Mygale fasciata* WALCK. *Hist. nat. des Aran.* IV. Pl. 1; Ceylon.

*Cteniza* LATR. Mandible furnished beneath, near the claw, with a row of horny barbs.

Sp. *Mygale cæmentaria* LATR., WALCK., *Hist. nat. des Aran.* III. Pl. 10:—*Mygale fodiens* WALCK., *Mygale Sauvagesii* LATR.: these species of southern Europe, which certain exotic species resemble, live in vertical tubular cavities underground, closed by a circular cover as by a door, and lined internally with silken web. On the inside of the cover are small impressions, to which the spider attaches itself by means of the hooklet of the jaws, holding fast to the walls of the tube with its feet, in order to keep the door close when an attempt is made to open it; this shuts down by its own weight. See SAUVAGES *Mém. de l'Acad. des Sc. de Paris*, 1758, *Hist.* p. 26, LATREILLE *Mémoires de la Soc. d'Hist. nat. de Paris*, &c., An. VII. 4to. pp. 118—128, Pl. VI., AUDOUIN *Ann. de la Soc. entom.* II. 1833, pp. 69—85. Pl. 4.

*Oletera* WALCK., *Atypus* LATR.

*Eriodon* LATR., *Missulena* WALCK.

*Anthrobia* TELLK. Ocelli none.

Lives in caverns. Ought it to be counted of this family?

Phalanx II. *Araneæ dipneumones.* Spinarets six. (Pulmonary sacs only two; stigmata mostly two, sometimes four, the two posterior leading to tracheæ, not to lungs. Ocelli mostly eight, sometimes fewer. Claw of mandible capable of inflection transversely or laterally to the inner margin of mandible).

Most of the spiders of this division have only two stigmata. In some, however, four are observed, and on that account the genera *Dysdera* and *Filistata* were placed by LATREILLE with *Mygale* (amongst the *Tetrapneumones*). But two of these stigmata do not lead to pulmonary sacs, but to air-tubes, and were also observed in *Argynoreta* by GRUBE. For the arrangement, therefore, this character of the number of stigmata is without weight, because it does not indicate natural affinity. The number of lung-sacs, on the other hand, appears to be in harmony with the characters derived from the mandibles and from the number of spinarets.

A. *Tubitelæ.* Spinarets cylindrical, parallel, collected into a fasciculus, directed backwards. Ocelli six or eight disposed in two rows (in one genus only two). Fourth or first pair of legs very long; intermediate legs shorter.

*Legs when at rest retracted upwards, with femora not pressed against the ground. Spiders weaving webs, resembling tubes or fishing-nets, and hidden in chinks, corners, or under stones.*

*Nops* MAC LEAY. (The eyes excepted almost similar to *Dysdera* LATR.)

Sp. *Nops Guanabacoæ* MAC LEAY, *Ann. of nat. Hist.* II. 1838, Pl. I, fig. 1, Cuba. The only species of spider hitherto known with only two eyes.

†† *Ocelli six.*

*Dysdera* LATR. Ocelli almost contiguous, arranged in two rows; the first row of two, the second of four ocelli. The first pair of feet surpassing in length all the rest, the fourth pair the intermediate.

Sp. *Dysdera erythrina* WALCK., *Aranea rufipes* FABR., LATR. *Gener. Crust. et Ins.* Tab. V. fig. 3, HAHN *Arachn.* Tab. I. fig. 3; in south of Germany, &c.

*Segestria* LATR. Ocelli arranged in two rows; the anterior row of four, the posterior of two remote. Feet as in the preceding genus.

Sp. *Segestria senoculata* WALCKEN., *Aranea senoculata* L., DE GEER *Mém.* VII. Pl. 15, fig. 5, WALCKEN. *Aranéid.* Tab. I. Pl. 7, &c.

*Scytodes* LATR. Ocelli six, equal, disposed in pairs, forming a triangle with the vertex forwards.

Sp. *Scytodes thoracica* LATR. *Gener. Crust. et Ins.* Tab. V. fig. 4, WALCKEN. *Aranéid.* I. Pl. 10.

Add genera *Ariadne* SAV. and *Uptiotes* WALCK.

††† *Ocelli eight.*

*Clotho* WALCKEN.

*Drassus* WALCKEN.

*Asegena* SUNDEV.

*Clubiona* LATR. Ocelli arranged in two lines transverse, approximate. Maxillæ straight, subdilated outwards at the base, rounded at the apex. Labium elongato-subquadrate, truncated or emarginate at the apex.

Sp. *Clubiona holosericea* LATR., *Aranea holosericea* L., DE GEER *Mém.* VII. Pl. 15, figs. 13—16, WALCK. *Aranéid.* IV. Pl. 3; mouse-grey, satiny-shining, with an elongate pointed abdomen. The female lays her eggs between one or two leaves spun together.

*Anyphœna* SUNDEV.

*Ciniflo* BLACKW.

*Argyroneta* LATR. Ocelli eight, four middle forming a square (.˙::˙.). Maxillæ straight, rounded at the apex. Labium elongato-trigonal.

Sp. *Argyroneta aquatica* LATR., *Aranea aquatica* L., CLERCK *Aran.* Pl. 6, Tab. 8, DE GEER *Mém.* VII. Pl. 19, figs. 5—13, HAHN *Arachn.* Tab. 49, fig. 118, HERRICH-SCHÆFFER *D. Ins.* Heft 134, Tab. 21, 22; ♂‴ long; one of our largest native species; thorax red-brown, abdomen blackish, the first pair of legs longer the rest. This spider lives in fresh water; as it swims the abdomen and the thorax have a silvery aspect from the attached stratum of air. This species spins a bell-shaped, water-proof web that is filled with air, and open below; this it attaches to water-plants by threads. See the observations of DE GEER loc. cit. p. 303—313, those of DE LIGNAC, &c. (of which WALCKENAER gives an ample extract in his *Hist. nat. des*

*Aptères*, II. pp. 380 and foll.), and of E. GRUBE in FROREIP'S *Neue Notizen*, XXIV. 1842, No. XXI. XXII. s. 321—328, s. 341—344.

*Aranea* LATR. (species from genus *Aranea* L.), *Tegenaria* WALCKEN. Ocelli eight, arranged in two lines transverse, approximate. Maxillæ straight. Labium subquadrate. Feet of the fourth and fifth pairs longer, subequal.

Sp. *Aranea domestica* L., ALBIN *Spiders*, Pl. 18, fig. 87, CLERCK *Aran.* Pl. 2, Tab. 9, WALCK. *Aptères*, Pl. 16, fig. 2. They weave close, adhesive, nearly horizontal webs in the corners of walls, in chamber-windows, &c., and a tube close by the net in a lurking-place, in which they wait for their prey. The anatomy of this species has been treated of especially by TREVIRANUS, in his classical Monograph *Ueber den innern Bau der Arachniden.*

*Agelena* WALCKEN. (and *Cœlotes* BLACKW.)

*Megamyrmœkion* REUSS, *Dyction* WALCKEN. [Is this its place?]

*Filistata* LATR.

B. *Iniquitelæ* LATR. Spinarets conical, convergent. Ocelli remote from the anterior margin, not describing a segment of a circle or a lune. Feet slender, drawn upwards when at rest; first pair mostly the longest of all.

*Spiders making nets, arranged irregularly, with threads intersecting one another in all directions.*

*Pholcus* WALCKEN. Ocelli, two middle less, placed transversely, three on each side larger, grouped in a triangle (⁘). Feet elongate, very slender; first pair longest of all, second longer than fourth, third shortest of all. Maxillæ incumbent on labium, elongate, narrowed towards the apex.

Sp. *Pholcus phalangioïdes* WALCK., *Aran.* V. Pl. 10, *Apt.* Pl. 8, figs. 2, 3; pale yellowish grey, the abdomen elongate. This species lives in the angles of walls, &c. in houses.

*Episinus* WALCKEN.

Is this its place?

*Latrodectus* WALCKEN. Ocelli subequal, four middle and two lateral on each side placed on a tubercle, remote from each other. First pair of feet longest of all, fourth longer than second and third.

Sp. *Latrodectus malmignatus* WALCK., *Aranea 13 guttata* ROSSI, FABR., ROSSI *Faun. etrusca* Pl. IX. fig. 10, WALCK. *Aran.* I. Pl. 5; this species is found in Italy and Corsica, and named *ragno malmignato;* it has thirteen carmine-red spots on the abdomen. Its bite is poisonous, and causes strong convulsions. Compare A. RAIKEM *Recherches sur le Theridion marmignatte de Volterra, et sur les effets de sa morsure. Ann. des Sc. nat.* 2e Série, Tom. XI. 1839, *Zool.* pp. 1—27.

*Note.*—LATREILLE joined this genus with the following, from which it scarcely differs except in the arrangement of the eyes.

*Theridion* WALCKEN. Ocelli subequal, mostly small, four middle disposed in form of a square, two lateral on both sides approximate, sometimes contiguous (∴). Feet of first and second pair longer than the rest.

Sub-genera: *Eucharia* KOCH, *Ero* KOCH, *Pachygnatha* SUNDEV., *Steatoda* SUNDEV., *Dictyna* SUNDEV. (*Ergatis* BLACKW.)

Sp. *Theridion benignum* WALCK., WALCKEN. *Aranéid.* V. Pl. 8, KOCH *Arachn.* III. Tab. 83, figs. 184, 185; a small grey spider much found amongst grapes, and whose fine web protects them from other insects.

*Bolyphantes* KOCH. (*Neriene* BLACKW.)

*Argus* WALCKEN.

*Erigone* SAVIGNY.

*Micryphantes* KOCH. (*Walckenaëra* BLACKW.)

C. *Orbitelæ* LATR. Spinarets conical, convergent. Ocelli near the margin of the cephalothorax inflected forwards, not disposed in a segment of a circle or a lune. Maxillæ straight, broader towards the extremity. First and second pairs of feet longer than the rest, the first pair longest of all.

*Spiders weaving nets orbiculate, formed of concentric circular and straight threads, radiating from the common centre. Legs when at rest drawn upwards.*

*Linyphia* LATR. Ocelli four middle, placed in two rows; the posterior more remote; two lateral on each side approximate, placed obliquely. Maxillæ substraight, remote.

Compare WALCKENAER *Hist. nat. des Apt.* II. pp. 233—284. A genus intermediate between this family and the preceding, to which it might perhaps be more correctly consigned.

*Manduculus* BLACKW.

*Uloborus* LATR.

*Tetragnatha* WALCK. Ocelli subequal arranged in two rows transverse, straight, almost parallel. Maxillæ elongate, divergent, dilated on the outer side towards the apex. Feet elongate, slender.

*Epeira* WALCK. Ocelli subequal, four middle arranged in a square, two on each side more remote from the middle four, placed obliquely. Maxillæ broad, short.

Sub-genera: *Singa* KOCH, *Zilla* KOCH, *Miranda* KOCH, *Atea* KOCH, *Argyopes* SAV., *Nephila* LEACH, *Micrathena* SUNDEV., *Acrosoma* PERTY, *Gasteracantha* LATR. (*Plectana* WALCK.)

*Mithras* KOCH. With two external ocelli of the first row very small, microscopic.

The net of the spiders of this genus is mostly placed in a vertical plane, sometimes obliquely. Only one species is known with which it lies horizontally. (*Epeira cucurbitana, Aranea cucurbitana* L., CLERCK *Aran.* Pl. 2, Tab. 4, WALCK. *Hist. d. Aran.* II. 3.)

To this genus belongs the *Cross spider, Epeira diadema, Aranea diadema* L., CLERCK Pl. 1, figs. 4, 5, RŒSEL *Ins.* IV. Tab. 35 to 40; BRANDT u. RATZEBURG *Med. Zool.* II. Tab. XIV. figs, 1—4; with a broad, triangular, toothed band of a darker colour on the dorsal surface of the abdomen, and a triple cross of whitish-yellow spots upon the band; the female has a large oval abdomen. This species, everywhere known, is common in gardens, especially in autumn.

Of the exotic species some have a resemblance to small crabs; they have a very hard horny skin on the abdomen, which moreover is armed with spines or long points; *Gasteracantha* LATR. Sp. *Epeira cancriformis*, SLABBER *Nat. Verlust.* Tab. 1, *schulpspin*, WALCK. *Aranéid.* III. Pl. 4, &c.

D. *Laterigradæ* LATR. Ocelli mostly arranged in a lunated form or in a segment of a circle. Body depressed, with cephalothorax suborbicular, small or moderate. Four anterior feet mostly longer than the rest.

*Spiders not weaving a web, but either drawing out some sparse viscid strings, or constructing a house amongst leaves contorted at the margins. Feet at rest extended, with femora pressed on the ground.*

*Selenops* DUFOUR.

*Sparassus* WALCK., *Micrommata* LATR. Ocelli arranged in two rows, the anterior row narrower, convex (⁘). Maxillæ straight, distant, parallel.

Sp. *Sparassus smaragdulus* WALCK., *Aranea smaragdina* FABR., CLERCK *Aran.* Pl. 6, Tab. 4, and 7, DE GEER *Mém.* VII. Pl. 18, fig. 6.

*Olios* WALCK., *Sarotes* SUNDEV.

*Philodromus* LATR.

*Thomisus* WALCK. Ocelli subequal, arranged in two rows convex anteriorly, the posterior row broader.

*Xysticus* KOCH. External ocellus of the anterior row large, the rest small, subequal.

Compare KOCH *Uebersicht des Arachnidensystems* Erstes Heft, 1837, s. 25, 26.

E. *Citigradæ* LATR. Ocelli occupying a larger area, arranged in form of a curvilinear triangle, or of a trapezium, or of an ellipse. Cephalothorax lofty, ovate, narrower anteriorly.

*Erratic spiders, not constructing webs or nets to capture prey, pursuing their prey by running.*

The females of many species sit upon the web of eggs to guard them, or bear their eggs about with them in a round sac. They also protect their newly hatched young for some time.

*Ctenus* WALCK. Ocelli arranged in three rows 2, 4, 2, the last two more remote (.:':.).

Most of the species American; Comp. WALCKEN. *Apt.* I. pp. 363—370.

*Dolomedes* LATR. Ocelli unequal, arranged in three rows, in the anterior row four, all or the two middle being smaller, in the second and third rows two larger; ocelli of the third row most distant frome ach other (:.:.:).

Sp. *Dolomedes mirabilis* LATR., *Aranea obscura* FABR., CLERCK *Aran.* Pl. 5, Tab. 10, DE GEER *Mém.* VII. Pl. 16, figs. 1—8, WALCK. *Aranéid.* I. Pl. 9; the female carries the sac of eggs with her under the thorax, holding them fast with her jaws and feelers.

Sub-genus *Ocyale* SAV., SUNDEV.

*Lycosa* LATR. Ocelli unequal, arranged in three rows almost equal, the first row having four smaller, the others two larger (:::).

These species live on the ground, and run very rapidly. The females carry their egg-sac with them, which is attached by a few threads to the abdomen. Sp. *Lycosa saccata* L., FRISCH *Beschr. v. allerl. Ins.* VIII. Tab. 2, CLERCK *Aran. Suec.* Pl. 4, Tab. 8, fig. 2, KOCH in HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 120, Tab. 8. This species is the most common in the north of Europe. To this genus and probably to this species is to be referred the account by BONNET of a contest between a spider and an ant-lion, into whose hole it had fallen. *Contemp. de la nat.*, XIIIème Partie, chap. 42. (*Œuvres compl.* éd. 8vo. Tom. IX. pp. 411, 412.)

To the genus *Lycosa* some larger species also belong; these are the celebrated *Tarantulæ* (*Aranea Tarantula* L.) of the south of Europe and various other regions of the old world. They are of different species. The true Tarantula of Italy and Spain (*Lycosa tarantula Apuliæ* WALCK.) is figured, amongst others, by ALBIN *Spiders* Pl. 38, HAHN *Arachnid.* I. Tab. 23, GUÉRIN *Iconogr., Arachn.* Pl. 1, fig. 6; according to WALCKENAER that found by LÉON DUFOUR in Spain is a different species, *Ann. des Sc. nat.* 2e Série III. 1835, Pl. 5, fig. 1; this spider, according to his observation, lives in holes in the earth, of which the outlet is surrounded by a little raised wall that is covered on the inside with web. That the bite of this spider is said to be followed by a dancing madness, that can be cured by music, is as well known as it is incredible.

*Sphasus* WALCK., *Oxyopes* LATR. Ocelli unequal disposed in four pairs, those of the first pair approximate, of the third pair most remote of all (∴).

(The genus is allied to the next subdivision, and perhaps might more correctly be placed there.)

Sp. *Sphasus heteropthalmus* WALCK., *Oxyopes variegatus* LATR., *Gen. Crust. et Ins.* Tab. 4, fig. 9, WALCK. *Hist. d'Aran.* III. Pl. 8, &c.

F. *Saltigradæ* LATR. Ocelli unequal, arranged nearly in the form of a square; the anterior lateral placed towards the angles of the anterior margin of cephalothorax, the two posterior remote from each other by the whole breadth of cephalothorax, or opposite to the former. First pair of feet with thighs mostly thick. Thorax large, deep, oblong.

*Erratic spiders, not forming nets, pursuing their prey by running and rushing upon it with a leap.*

*Myrmecium* LATR. Ocelli arranged in three rows; the anterior of four ocelli, with two middle larger forming with the second row a square; the two last distant, set on tubercles. Cephalothorax divided by strictures, elongate. Abdomen small. Feet slender.

Sp. *Myrmecium rufum* LATR., *Annal. des Sc. nat.* III. 1824, pp. 23—27, Pl. 2, from Brazil. Other species, all from America, are noticed by WALCKEN. *Apt.* I. pp. 386—388.

*Chersis* SAV., WALCK., (*Palpimanus* DUF.)

*Eresus* WALCK. Two middle ocelli of the first row forming with the second row a square, inscribed in a larger square, formed by the lateral ocelli of the first row and the two last (⁘). Feet thick.

Sp. *Eresus cinnaberinus, Aranea moniligera* VILLERS *Entom. Linn.* Tab. XI. fig. 8, WALCK. *Aranéid.* II. Pl. 10, south of Europe, &c.

*Attus* WALCK., *Salticus* LATR. Ocelli arranged in form of a square open behind or of a horse shoe, with two posterior remote, opposite to the laterals of the first row; two middle anterior ocelli larger, the two of the second row smallest of all (⁘).

Sp. *Attus scenicus* WALCK., *Aranea scenica* L., ALBIN *Spiders* Pl. III. figs. 12, 14, DE GEER *Mém.* VII. Pl. 17, figs. 8—10, PANZER *Deutschl. Ins.* Heft 40, Tab. 22 (called *Aran. cingulatæ*) &c.

This genus, with *Epeira* the most numerous in species in the whole division of spiders, presents, in the relative length of the legs, and in the relative size of the different ocelli, some variations. See WALCK. *Apt.* I. pp. 483—488 and SUNDEVALL *Conspect. Arachnid.* pp. 25—27.

# CLASS X.

## CRUSTACEANS (*CRUSTACEA*)[1].

THE class of crustaceans is the last of articulate animals with articulate feet (see above, p. 248), all of which LINNÆUS regarded as insects. They breathe by means of gills, and there are no air-passages or stigmata present as in insects. They are distinguished from the preceding class by the presence of abdominal feet. The myriapods alone agree with the crustaceans in this respect, and are by some writers enumerated amongst them, with which, however, on account of the presence of air-passages and air-tubes and of their resemblance to insect-larvæ, they ought not in our opinion to be united.

The name of the class is derived from the nature of their external covering; this is in most cases hard, and contains a greater or smaller quantity of carbonate of lime. In other instances, however, the integument is more leathery or horny. The tissue which supplies a foundation for the hard calcareous shell, is still the same *chitine* which forms the dermal skeleton in the entire division of articulate animals with articulate feet (p. 284). The shell consists of different layers, with a layer of pigment beneath or equably penetrated by colouring matter. Between the rings

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[1] Besides the works of LATREILLE already cited under the insects, p. 247 (*Hist. nat. des Crust. et des Ins.*, and *Genera Crustaceor. et Insector.*) we would mention as principal works:—

J. P. W. HERBST, *Versuch einer Naturgeschichte der Krabben und Krebse.* III. Bd., *m. illum. Kupfertaf.* 4to. Berlin u. Stralsund, 1782—1804.

SUCKOW, *Anatomisch-physiologische Untersuchungen der Insekten und Krüstenthiere.* Heidelberg, 1818, 4to.

A. E. DESMAREST, *Considérations générales sur la classe des Crustacés.* Paris, 1825, 8vo. avec 56 pl. In this work (pp. 396—420) there is a copious list of writings on the class of the crustaceans.

MILNE EDWARDS, *Histoire naturelle des crustacés*, av. pl. Paris, 1834—1840, III. Vols. 8vo.

TH. BELL, *History of British Crustacea*, London, 1853.

Also the article *Crustacea* by the same author in TODD'S *Cyclopædia* I. pp. 750—787 may be consulted. For the fossil species BROGNIART et DESMAREST, *Hist. nat. des Crustacés fossiles sous les rapports zoologiques et géologiques.* Paris, 1822, 4to.

(segments) and in the joints alone is the integument thinner and more flexible.

Let us first consider the external structure of these animals a little more closely. We have seen above that the body of insects, the myriapods excepted, is divided into *head*, *trunk* and *abdomen*. Such a division as this does not occur in the crustaceans. In many the head is not distinct from the thorax, and its place is indicated solely by the position of the eyes, the attachment of the antennæ and the presence of the mouth; it is most completely connected and, as it were, intimately fused with a large part of the body, in which the principal viscera are contained, and which may be compared not with the thorax alone of insects, but also with the anterior portion of their abdomen. To this part of the body another succeeds, in which only the posterior portion of the intestinal canal and of the nervous system is contained, and which is commonly called the tail; thus it is for instance in the cray-fishes. In other instances the hindmost portion is less obviously separated from the trunk, and the entire body is parted into rings or segments. In the *Xiphisoura* the divisions or segments are not recognisable on the dorsal surface, for the body is parted into two shields alone, to which a long and pointed appendage is attached posteriorly. In others the *cephalothorax* is more or less distinct from the rest of the body, which is not obviously divided into segments but is covered by a bivalve, membranaceo-horny shell (*Cypris*). In the *Cirripedia* the partition into segments ceases; the body ends with a thin tail without appendage. They are surrounded by a mantle, in which, as in the class of the mollusca, calcareous plates are formed which resemble the shells of these animals.

To the anterior portion of the cephalothorax, or to the head itself, whenever it is distinct, the antennæ, eyes and oral organs are attached. When there are four antennæ, as is the case with most, they are placed either in the same plane, or the one pair is placed above the other, so that according to their position they may be distinguished as middle and external, or as upper and lower. The external or lateral antennæ are implanted close to the eyes, sometimes beneath the eyes. They consist commonly of three or four larger and thicker joints at the base, and a filiform part, terminating finely and composed of numerous joints. Sometimes the antennæ terminate in two or three filaments of this kind. In some the

antennæ are short, in others very long; the external are commonly the longest, and in the genus *Palinurus* exceed twice the length of the body. In some genera there are only two antennæ present; the genus *Limulus* has no antennæ at all.

There are commonly two compound eyes, or two groups of simple eyes. The simultaneous presence of two compound eyes with simple eyes, so common in the winged insects, is observed in only very few crustaceans. In most of these there are only two compound eyes, which are often fixed upon a pedicle and moveable.

The mouth of crustaceans is situated on the inferior surface of the anterior portion of the body. The oral organs or jaws are arranged in pairs and move sideways, as in manducating insects. In some crustaceans, however, these parts acquire a modified form, and compose a sucker for taking up fluids, on which these animals live. The description of the jaws may well detain us some moments, and requires a more particular survey according to the different orders.

In the ten-footed crustaceans (lobsters and crabs) a transverse upper lip is present; beneath it lies a pair of upper jaws, which are very hard, cut off straight at the extremity, and at the upper margin provided with a short feeler of two or three joints. [Since the upper jaws (*mandibulæ*) in insects are without feelers, it has been thought that these joints do not represent a *palpus*, but a continuation of the pedicle of the jaws: at all events this *palpus* differs from that which occurs on the accessory under-jaws of crustaceans.]

A thin, membranous, bifid tongue, is situated at the base of the upper jaws[1]. To it there succeed a first pair of under-jaws, which are membranous, divided into lobes and beset with hairs at the margin. Next follows a second pair of under-jaws, which are also membranous and haired, and may be compared with the under-lip of insects which has been split into two parts. Then follow three pairs of jaws, or rather of feet changed into jaws, to be compared with the six feet of insects. At the outside of these accessory jaws a *palpus* is attached, which, as external division of the foot, does not correspond with the *palpi* of insects, and was named *flagrum* by SAVIGNY. This *flagrum* consists of a flat, elongated part at the *basis*, and a many-jointed filament running to a point at the end.

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[1] CUVIER calls this part *sixième mâchoir, Leç. d'Anat. comp.* III. p. 304; FABRICIUS gave it the name of *labium*.

The innermost part of the first pair of modified feet or accessory jaws is still fleshy and lobed, like the jaws that precede them; but the auxiliary jaws of the second and especially of the third pair, indicate by their form that they correspond to feet, and bear small gills at their base. In the short-tailed ten-footed crustaceans the third pair has two very broad joints (the two joints of the *femur*, according to SAVIGNY), so that it covers the oral organs on its under surface.

The auxiliary jaws of the two last pairs, which, as we have said, indicate by their form even in the decapod crustaceans most manifestly their true nature of feet, remain in many crustaceans, as in *Gammarus* and *Squilla*, unchanged feet. Hence these crustaceans have fourteen unchanged feet, and not ten like lobsters and crabs.

The genus *Apus* amongst the *Entomostraca* possesses those oral parts alone, which also occur in hexapod insects. To these succeed numerous feet, of which the first pair terminates in filaments consisting of many joints, but contributes nothing to mastication. In *Limulus* there are six pairs of feet at the *cephalothorax*, without any jaws; the broad basal pieces, armed with spines, of the ten last feet surround the mouth and perform the office of jaws, whilst the first pair of feet, scarcely a third of the length of the other feet, is placed in front of the mouth. It forms two false jaws that may be compared with the *mandibulæ* of the *Arachnoidea*, whilst the *coxa* is membranous, and unites with that of the opposite side to form a kind of upper-lip[1]. If we compare the second pair of feet with the so-named under-jaws of *Arachnids*, we shall observe the greatest agreement between *Limulus* and them. Behind the last pair of feet also in *Limulus* there are even found two small appendages, which may be compared with the pectinated organs of the scorpions.

The body of crustaceans in the more restricted sense or the trunk, the anterior portion of the abdomen, is almost always divided beneath by transverse indentations into sections, but its upper part in the decapod crustaceans is covered by a continuous shield, named the shell (*testa*, in French *carapace*[2]). In the short

[1] J. VAN DER HOEVEN, *Recherches sur l'Hist. nat. et l'Anat. des Limules.* Leide, 1838, folio, p. 12.

[2] In the shell DESMAREST has distinguished certain parts by particular terms, from the position, relative size and determinate form of which, the situation, magnitude

tailed crustaceans the pectoral shield is much developed and covers the body beneath as the shell does above. The first sternal portion is very large and is situated in the mid line of the body. To it succeed four smaller sternal pieces, which are divided in the middle more or less obviously since they consist of the union of two lateral pieces. To the first piece the first pair of feet is attached, that of the so-called shears or claws; to the four following the four following pairs are united. To the basal piece of the feet the lateral sternal pieces (*episternalia*) are attached, which lie on the outside of the middle pieces and fill up the truncated angles between them. The most posterior portion of the abdomen in the decapod crustaceans is always obviously divided into rings or segments, which are seven in number, or may be fewer from the fusion of some of the rings. The feet attached to these are short, commonly divided into two filaments; the hindmost ring bears no feet. These last abdominal rings are usually called the tail. In the crabs they are very feebly developed, and the flat tail is curved round and lies with its extremity turned forwards in a groove in the middle of the pectoral shield.

The intestinal canal of crustaceans is short and straight, and thus agrees with the nature of their food, which is animal. The *anus* is situated at the extremity of the abdomen or of the tail. In *Limulus*, however, the long styliform tail is not perforate, and the *anus* is situated on the inferior surface of the second shield, in front of the base of the tail. So is it also with the *Cirripedia*, where the jointless tube, improperly named *proboscis* by some, represents the tail, and where the intestinal canal opens at the base of this tubular prolongation. In some lower crustaceans the intestinal canal is nearly of the same width throughout its whole length, or has in the middle or more forward an expanded part, which may be considered as an imperfectly defined stomach[1]. In others an obviously distinct stomach is present, which is commonly armed with horny spines or with calcareous teeth. In *Limulus* the narrow œsophagus with longitudinal folds goes straight forwards and

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and form of the internal organs that lie beneath may be determined. See A. BROGNIART and A. G. DESMAREST, *Hist. nat. des Crust. fossiles*, pp. 73—79, and DESMAREST *Cons. gén. s. l. Crust.* pp. 20—23.

[1] This is the case, for instance, in *Asellus* (*Oniscus aquaticus* L.), see TREVIRANUS *Verm. Schr.* I. s. 73, Tab. XI. fig. 64, &c.

then curves into the stomach, which is placed almost perpendicularly. The stomach is compressed laterally, has thick muscular walls, and is armed internally with many oblong rows of horny spines. The pylorus projects conically into the intestine, which then proceeds horizontally backwards, lying in the first part of its course close upon the œsophagus that runs in the opposite direction, and lies below it[1]. In *Squilla* the stomach is small, muscular, triangular, armed in its posterior or pyloric portion with horny, pointed spines. In the ten-footed crustaceans the œsophagus mounts almost directly upwards. The stomach is capacious, and in its first part entirely membranous. The uppermost and hindmost or pyloric portion of the stomach is supported by hard parts, and therefore, even in the empty state, remains expanded. To these hard parts teeth are attached internally, by the assistance of which the food is comminuted. The *epithelium* of the stomach, moreover, is covered with numerous prolongations or colourless hairs, invisible to the naked eye, whose points are directed backwards[2]. To this stomach different muscles are attached, which arise on the inside of the *cephalothorax*, and which can also work upon the teeth described above. These muscles are, beyond doubt, subject to the will of the animal, and consequently we have here the rare example of an organ of vegetative life that is moved by muscles of animal life. In some ten-footed crustaceans one or more blind appendages to the intestinal canal are observed, which probably are secreting organs[3]. There are some species in which two such blind tubes terminate in the intestine close to the inferior opening of the stomach, whilst a single third tube is attached to the intestine lower down. It is, however, this last unpaired tube which alone occurs in most. Unless this tube be regarded as an organ for the secretion of urine, no parts are known which correspond to the *vasa urinaria* of

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[1] *Recherches sur l'Hist. nat. et l'Anat. des Limules*, p. 17, Pl. II. fig. 1 c, figs. 2—4.

[2] At the hindmost part of the stomach, behind and under the above-mentioned teeth, these hairs may be distinguished even with the naked eye. The stomach of the cray-fish has been often described and figured. We content ourselves with referring to the latest investigations alone, those of F. OESTERLEN, in MUELLER'S *Archiv*, 1840, s. 387—441, Taf. XII.

[3] See DUVERNOY in the second edition of CUVIER *Leç. d'Anat. comp.* V. pp. 228, 229. In as far as they open close to the *pylorus* these blind appendages may perhaps be compared with the *pancreas;* but ordinarily they are inserted further backwards.

insects. In *Oniscus* and *Porabea*, according to TREVIRANUS, four short vessels, which open into the rectum close to its extremity, may perhaps correspond to the urinary vessels, or, as he supposes, to the *biliary*, although they differ from them greatly by their shortness[1]. As little are salivary organs known hitherto, except in the *Cirripedia*. The liver, on the contrary, is commonly much developed here. In some lower crustaceans the intestinal canal is surrounded by a layer of small blind sacs (*folliculi*) or glandules, which may be regarded as a liver intimately connected with the intestine. In the *Cirripedia* the intestine below the stomach is surrounded by a liver formed of many blind sacs. In the *Oniscides* from two to six long blind liver-tubes are found, in most of the genera four, often with dilations like a string of beads, which are described by some writers as the adipose body of these animals. In *Bopyrus* the intestinal canal, according to RATHKE, receives seven liver-tubes on each side, which lie behind each other in the length, an arrangement which recalls that in the scorpions, whilst besides an unpaired liver-mass, incised into three parts, lies in front of the others on the stomach[2]. In *Limulus* there are two very wide gall-ducts on each side, at some distance behind the *pylorus*; they receive the blind convoluted tubes, of which the large liver-mass of this animal consists. In the decapod crustaceans only one gall-duct is found on each side, terminating in the intestinal canal, behind the lower orifice of the stomach. The liver is a double and symmetrical organ, as in most crustaceans, and each liver is divided more or less distinctly into three lobes; in each of these lobes runs a tube, that terminates in the common gall-duct, and round about the tubes blind sacs (*folliculi*) are set, which unite as fingers do. These follicles consist of three membranes, of which the internal and external present no special structure; the external is more consistent and more intimately connected with the middle membrane.

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[1] *Verm. Schr.* i. s. 58, Taf. VII. fig. 38, i. g.

[2] In *Squilla* the liver consists of lateral blind sacs divided into branches that extend throughout the whole intestinal canal, a disposition which agrees with that in *Bopyrus*, and may also be compared with that in *Aphrodita* (see above, p. 211). Above the liver, on the dorsal surface, lie the *testes* or *ovaria*, which also extend longitudinally, and consist of branched glandular lobes. The *ovaria* of *Squilla* were described by CUVIER as liver. See DUVERNOY *Ann. des Sc. nat.*, 2e Série, Tom. VI. 1836, pp. 247—251.

The middle membrane is formed of a layer of nucleated cells and granular tissue, and of cells with fat-globules[1].

The blood-circulation, which was already more developed in the highest arachnids, is here seen to be more and more perfected. In all the heart is situated on the dorsal surface, and is arterial. In the *Oniscides*, the *Stomapods*, and *Limulus* the heart has the form of an elongated dorsal vessel, from which on both sides branches arise, that are distributed to the different parts. In the *Lophyropoda* the heart is more oval, and situated in the anterior part of the body on the dorsal surface. In the ten-footed crustaceans (crays and crabs) the heart is roundish or hexagonal, much broader than the main trunks of the arteries, and is situated on the back between the third and fourth pairs of feet. The arteries in the crustaceans are very differently disposed; in some there seem to be only a few main trunks present, and the blood to flow elsewhere merely in the interspaces of the organs in determinate directions, without being inclosed in vascular walls. In the ten-footed crustaceans, where these vessels are best known, an artery arises from the foremost part of the heart, in the middle, which is specially destined for the eyes; and, besides some smaller branches which it gives off, divides close to the eyes into two branches. Next to this artery, there is one on each side which is distributed to the antennæ and neighbouring parts. More behind there arise, about the middle of the heart, on its under side, two arteries, one on each side, which run to the liver; lastly, at the posterior extremity of the heart, there arises a considerable single artery, which appears to fill the office of a posterior aorta, and gives off branches to the intestinal canal, to the generative organs, to the muscles of the abdomen, &c. AUDOUIN and MILNE EDWARDS name this vessel *sternal artery* (*artère sternale*). It presently divides into two main branches, of which one runs along the dorsal, the other the abdominal surface.

The veins in crustaceans, even in the most perfect order of the *Decapods*, are represented by cells or spaces between the organs of the body, in which the blood is moved without proper walls.

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[1] See T. F. G. SCHLEMM *De Hepate et Bile Crustaceorum et Molluscorum quorundam.* Berolini, 1844, 4to. pp. 13—16; H. MECKEL in MUELLER'S *Archiv*, 1846, s. 35—38.

These convey it into sinuses situated in the middle of the body or along the feet, and from which it flows to the gills. From the gills it returns to a sinus that surrounds the heart, and often in the ten-footed crustaceans is described as a *pericardium*. On the dorsal surface of the heart are fissures, which during the *diastole* of the organ afford an entrance to the arterial blood with which this sinus is distended[1]. The blood of crustaceans is whitish or purple, sometimes red, as in *Apus*. The velocity of the circulation is very different in different families of this class. CARUS, in the cray-fish, observed 51 beats in a minute[2], whilst in *Daphnia* 200 beats of the heart in a minute were remarked by JURINE and STRAUS DURCKHEIM[3].

The respiratory organs in the crustaceans consist of gills, which however are not met with in all, so that in some the skin itself appears to be the only organ of respiration. Also it is probable in a few that, at the same time that distinct gills are present, the skin is still partly serviceable for respiration, as in the lateral parts of the shield-like shell, in which the blood forms numerous currents, in *Apus* (according to ZADDACH) and in *Argulus*, in which last genus VOGT regards these parts as the sole seat of the respiratory function. The gills have the form either of plates that, consisting of two membranes, are properly flat sacs, or of filaments. In the *Cirripedia* both forms are met with; in *Anatifa* (and the other pediculated genera, *Lepadicea*) there are two or more pairs of soft conical filaments which, with the point turned upwards, are situated at the base of the pedicle of the *cirri;* whilst in the non-pediculated genera, the sea-acorns (*Balanidea*), fringed plates at the inside of the mantle are present. In many other genera, especially in the *Isopoda*, the gills appear under the simple form of certain pairs of flattened sacs; at the abdomen the feet are composed of two plates, of which the

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[1] Compare on the circulation of the crustaceans amongst others the observations of AUDOUIN and MILNE EDWARDS *Ann. des Sc. nat.* XI. 1827, pp. 283—314 and pp. 352—393; MILNE EDWARDS *Hist. nat. des Crust.* I. pp. 94—105; LUND in OKEN'S *Isis* 1829, s. 1299, A. D. KROHN (*Astacus fluviatilis*) ibid., 1834, s. 518—529, Taf. XII. Beautiful figures of the heart and vessels in *Astacus marinus*, after the preparations of HUNTER, are to be found in the *Catalog. of the Physiolog. Series of comp. anat. in the Museum of the Royal Coll. of Surgeons.* Vol. II. 1834. Pl. XV—XVIII. pp. 136—140.

[2] C. G. CARUS *Von den äusseren Lebensbedingungen der weiss- und kaltblütigen Thiere.* 1824, 4to. s. 83. The number of beats was increased by the stimulus of warmth, but became fewer and irregular under the influence of galvanism.

[3] *Mém. du Muséum* V. pp. 412, 413.

external, of firmer structure and commonly beset with hairs at the margin, protects as a gill-cover the innermost soft and sacciform plate, the proper gill. The normal number of gills is five pairs, but in the land *Oniscides* and *Asellus* there are only three pairs developed. In *Asellus* and many marine *Oniscides*, the gill-covers themselves contribute to respiration[1]. In most crustaceans indeed these two chief forms of plates or filaments become modified through greater development, and each gill consists not of a single plate or of a single thread, but of a large number of plates or threads. Thus in *Limulus*, on the upper surface of the five last abdominal feet, which have assumed the shape of flat semicircular discs, there are found five pairs of gills, each of a hundred plates or more, whilst the first pair of abdominal feet not bearing any gills at their base, but the external sexual organs, covers all the succeeding feet on the under-surface, after the manner of a gill-cover. In *Squilla* there are five pairs of gills, in the form of numerous filaments placed pectinately on a pedicle, which are attached to the base of the fin-like posterior feet. In the ten-footed short-tailed crustaceans there are commonly seven gills on each side, of which that in the middle is the longest. They have a pyramidal form and are divided longitudinally by a middle septum from the base to the apex; on this septum numerous plates are set at right angles which make up the pyramidal body of the gills, and consist of folds of the double membrane of which the septum is composed; these plates thus form sacs which may be inflated through the septum. In some long-tailed decapods also the gills are leaf-shaped but in most they consist of a multitude of fine cylindrical filaments which are attached instead of plates to each side of the axis of the gill. The gills are more numerous, sometimes even twenty-one on each side. In all the decapod crustaceans the gills are situated under the lateral parts of the shell (*carapace*) in a proper cavity on each side, and are attached to the basal piece of the five pairs of feet, or at the same time to the hindmost foot-jaws also. The water penetrates to the respiratory cavity by an opening on each side at the inferior margin; in the short-tailed this opening is situated in front of the basal piece of

[1] TREVIRANUS *Verm. Schr.* I. s. 60—62, Tab. IX. figs. 50—52, s. 73—75, Tab. XII. figs. 63—65. Compare also DUVERNOY et LEREBOULLET *Essai d'une Monographie des organes de la respiration de l'ordre des Crustacés isopodes. Ann. des Sc. nat.* 2e Série, Tom. XV. *Zoolog.* pp. 177—240, Pl. VI.

the first pair of feet; in the long-tailed it is a fissure that extends along the entire *thoraæ* on each side. The water is expelled, on the other hand, along a furrow which opens forwards by the side of the mouth. In this canal an oval lamina is situated, which is the outermost lobe of the second pair of maxillæ, and produces by its motion a current forwards to force the water out[1].

In nearly all crustaceans the two sexes are distinct. In the *Cirripedia*, indeed, formerly counted amongst the Molluscs, the male and female sexual organs are united in the same individual[2]: [except in certain genera of the *Lepadicea*, as *Ibla* and *Scalpellum* LEACH, where there are not only, according to DARWIN, males and females distinct, but also the surprising fact of 'hermaphrodites whose masculine efficiency is aided by one or more complemental males[3],' often exceedingly minute, and rudimentary in structure, which are permanently attached to different parts of the female.] The ovary lies as an apparently granular mass in the pedicle of *Anatifa*, and under the microscope is seen to be composed of rounded lobes; a tube which traverses the pedicle and opens into the mantle above by a fine aperture on the dorsal surface is the oviduct. In *Balanus* the ovary lies in the walls of the mantle. [According to DARWIN the female organs consist of true ovaria (salivary glands CUV.) seated on each side near the base of the labrum, of unbranched ovarian ducts and of ovarian branching tubes and cœca. In the *Lepadicea* the ovarian tubes branch out in all directions within the peduncle, and ova are developed in the footstalks of their branches as well as at their ends. Two unbranched tubes enter the body of the Cirripede from the pedunele and run into the two true ovaria situated at the base of the labrum and resting on the upper edge of

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[1] See MILNE EDWARDS *Recherches sur le mécanisme de la respiration chez les Crustacés. Ann. des Sc. nat.* 2e Série, Tom. XI. *Zoologie*, pp. 129—142.

[2] A few years ago GOODSIR described small crustaceans, with five pairs of feet, as the males of *Balanus*. *Edinb. new Philos. Journ.* XXV. 1843, p. 88, *Ann. des. Sc. nat.* 3ième Sér. I. 1844, pp. 107—117. These supposed male individuals present however little or no resemblance to the juvenile form of Cirripedes, as we have been taught to know them by BURMEISTER.

[3] DARWIN *Lepadidæ*, 1851, p. 182. DARWIN found the animals described by GOODSIR not to be males but females distended with ova. He considers them to be the females of the unnamed genus belonging to the family of Ioniens, described by GOODSIR, which live parasitically within the sac of the Balani. See DARWIN *Monogr. of the Cirripedia, Balanidæ*. London, 1853, p. 271.

the stomach. These tubular glands are generally divided at the end near the mouth into a few blunt branches. Their precise connexion with the two main ducts has not been discovered. The state of these two masses varied much—but since, at times, they contained aggregations of matter consisting of little balls closely resembling, in general appearance and size, the ovigerms with their germinal vesicles and spots, there could be no doubt that they are ovaria. DARWIN was unable to discover the orifice by which ST. ANGE supposes the ova to enter the sac. His observations lead him to believe that the mode by which they enter the sac is quite different: "Immediately before one of the periods of exuviation, the ova burst from the ovarian tubes in the peduncle and round the sac, and, carried along the circulatory channels, are collected beneath the chitine-tunic of the sac, in the corium, at this period remarkably spongy and full of cavities. The corium then forms, or rather, (as DARWIN believes,) resolves itself into a delicate membrane enveloping each ovum and uniting them together in lamellæ; the corium, having thus far retreated, then forms under the lamellæ the chitine-tunic of the sac, and the last-formed one is immediately moulted with the other integuments of the body. The membranes harden, the lamellæ of ova become detached from the bottom of the sac, and are attached to the ovigerous frœna." In the *Balanoidea* the branching and inosculating ovarian cœca form a layer covering in part the basis of the balanus, and in certain cases extending upwards between the two layers of corium round the walls of the shell[1].] The testes lie on the sides of the body as small blind sacs that are attached to branches that coalesce to form larger stems like veins. On each side there arises from the union of these branches a wide and tortuous canal (*vas deferens*), which afterwards becoming narrower advances towards that of the opposite side; thus these two tubes lie close together at the base of the caudiform appendage of the body, where they unite to form a *ductus ejaculatorius*, which opens at the apex of the appendage[2]. In some lower crustaceans the females are much more numerous than the males, which are only imperfectly

[1] DARWIN *Lepadidæ*, pp. 56—60, and *Monogr. of the Balanidæ*, London, 1854, p. 100.

[2] WAGNER in MUELLER'S *Archiv*, 1834, s. 467—473, Tab. VIII. figs. 8—11, 13; MARTIN ST. ANGE *Mém. sur l'organisation des Cirripèdes*. Paris, 1835, 4to. pp. 20—22, Pl. II. figs. 4—7.

or not at all known. In certain of them the males occur only at particular times of the year, and the females, like the leaf-lice, are fruitful without copulation through several successive generations, as in *Daphnia* and, according to JOLY, in *Artemia*. In others the males may, on account of their minuteness, have eluded observation, as in the parasitic genus *Bopyrus*, where they are surpassed in size by the female about four times. Besides the unequal size, the full-grown female in this and in other parasitic genera (Siphonostomes) often present a very deviating form. The sexual difference in the common form has not yet in the higher crustaceans been sufficiently investigated in the different families. In the different species of *Limulus* that difference is known pretty accurately. In the long-tailed ten-footed crustaceans the males have larger claws than the females, the last a broader abdomen than the first.

As a rule the internal and external sexual organs are double. In *Argulus* there is only one ovary with one oviduct opening between the two hindmost natatory feet, whilst however the external organs in the male are double[1]. The ovaries are ordinarily two blind sacs, as for instance in the Isopods, elongate blind tubes. Only seldom are they divided into branches, as in *Chondracanthus* according to RATHKE, in *Apus*[2] and *Limulus*. They pass into two oviducts, which open each separately. In *Limulus* the two vulvæ are near the first pair of abdominal feet, close to the *basis* at the dorsal surface. In the ten-footed crustaceans these two external openings are situated on the cephalothorax, between the feet of the third pair, or on the base of these feet themselves. Only seldom, as in *Bopyrus*, do the two oviducts coalesce to form a single tube that opens into a single *vulva*. Sometimes there are yet accessory female organs, for the secretion of a covering of viscid fluid, either to cover the eggs, or to take up the *sperma*, as the two large *bursæ copulatrices* in the short-tailed decapods[3]. The testes also have often

[1] Here at the first joint of the fourth pair of swimming-feet is seen a tubercle with a hook directed backward. JURINE, *Ann. du Muséum*, VII. pp. 448, 449, Pl. 26, figs. 2, 3, fig. 21.

[2] ZADDACH, *De Apodis cancriformis Anatome et Historia evolutionis*, Bonnæ, 1841, 4to pp. 51, 52, Tab. I, fig. 14.

[3] See CARUS *Tabul. anat. comp. illustr.* Fasc. v. Tab. 3, fig. 7, *f*; comp. MILNE EDWARDS *Hist. nat. des Crust.* I. pp. 171—174; according to the observations of this naturalist there is no room for doubt respecting the function of these parts (as *poches copulatrices*).

the form of two blind sacs. Sometimes, as in the decapods, these have a more glandular aspect, and consist of an aggregate of many follicles. In the long-tailed ten-footed crustaceans the two *testes* form a single three-lobed body, though there are two *vasa deferentia*. These efferent tubes open in these crustaceans, as also in the short-tailed or crabs, at the base of the feet of the fifth pair. In these animals the external male organs of copulation have horny accessory organs attached to the first two abdominal rings which support the *penis* in copulation, and which as to their function may be compared with the little bone that occurs in this part in some mammals.

The eggs of crustaceans after they have been laid often continue attached to different parts of the parent's body, and there advance to further development. In the *Oniscides*, and many other crustaceans, the development takes place in a brooding cavity at the under surface of the anterior part of the body, where it is covered by a different number, commonly by five pairs, of ventral plates lying on one another like roof-tiles[1]. In *Daphnia* the eggs remain for some time in a cavity beneath the shell on the back; in *Cyclops* they are carried about in two bunches by the female at the base of the abdomen. The same is observed in many parasitic crustaceans. In others they are attached to the feet by an adhesive fluid hardened into threads; in the ten-footed crustaceans, to the feet of the abdomen or of the so-called tail. Other crustaceans divest themselves of their eggs without bearing them about on their body, and attach them to other objects. Thus the female of *Argulus foliaceus* affixes her numerous eggs (100—200) by means of a viscid covering to stones[2]. *Cypris* also lays her eggs upon different bodies under water, often in heaps of a hundred, which she covers with a green thready matter[3].

The egg of crustaceans, whilst still in the ovary, consists of the yolk, the germ vesicle, and the vitelline membrane. The yolk is slightly fluid, and consists of shapeless fat-particles and cells, with only a small quantity of albuminous fluid. The germ-vesicle, which again includes different small vesicles (germ-spots), disappears after impregnation, as soon as the egg enters the oviduct. Here, on the other hand, it receives an external covering, a chorion, formed

[1] TREVIRANUS *Verm. Schr.* I. Tab. IX. figs. 51, 52.
[2] JURINE, l. l. pp. 452, 453. [3] STRAUS, *Mém. du Mus.* VII. p. 54.

from a coagulable fluid, which has been secreted by the oviduct. This covering is thicker than the vitelline membrane, and between the two only a small space or none at all remains; in the first case a watery albuminous fluid occupies it. The production of the germ is, as in the egg of many other animals, both vertebrate and invertebrate, so also in that of many crustaceans, preceded by a parting and cleaving of the yolk[1]. There arise first in the yolk a greater or lesser number of membranous saccules, follicles which probably take their origin from the albuminous fluid portion of the yolk, and enclose a greater or lesser number of yolk-cells. The germ first appears as a nebulous grey spot, which consists of cells that have nuclei, and probably arise from modified yolk-cells. At first the germ is small, afterwards the germinal membrane grows round the whole of the yolk. It separates into two layers, which may be compared to the *serous* lamina and the *mucous* lamina in the *blastoderma* of vertebrates. Just as in insects and arachnids, the ventral parts of the walls of the body are the first that come into being. The parting of the body into rings or segments begins on the ventral surface. All the appendages (limbs, jaws, feet) greatly resemble one another at first, and on the whole the anterior members are formed first, the posterior last. Many crustaceans make their appearance from the egg with fewer limbs than they afterwards possess. But the development of crustaceans presents many differences, in the different orders, of which the particular description would demand too large a space. Such an uniformity of the plan of development, as we observe in the classes of vertebrate animals, seems in the lower classes of animals not to occur[2].

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[1] ERDL did not perceive the cleaving in the eggs of *Astacus marinus*, but did in those of *Cancer mænas*. In this last RATHKE also observed the phenomenon, as well as in *Gammarus fluviatilis* and *G. Locusta*, KOELLIKER in *Ergasitus* and *Cyclops*.

[2] As the comparative history of development in general, so especially has that of crustaceans, received its clearest illustration from the unwearied and distinguished investigations of H. RATHKE. We cite here his *Untersuchungen über die Bildung u. Entwickelung des Flusskrebses*, mit 5 Kupfert. Leipzig. 1829, folio (from which ample extracts are given with many figures in the *Ann. des Sc. natur.* Tom. XX. 1830, pp. 442—469); *Abhandlungen zur Bildungs-und Entwickelungsgesch.* II. 1833, s. 69—94, (in *Asellus aquaticus, Oniscus murarius, Daphnia, Lynceus*), and especially for the numerous investigations in very different families of crustaceans, his work, *Zur Morphologie, Reisebemerkungen aus Taurien*. Riga u. Leipzig, 1837, 4to. s. 35—151. See also the compressed review of this subject by RATHKE, in the second edition of BUR-

In very many crustaceans extremely remarkable metamorphoses have been observed, which, however, are confined to the first period of life; long before they are full-grown, they have attained their permanent form, and after that only undergo repeated moultings. The young of *Cyclops*, already observed by LEEUWENHOECK and afterwards by DE GEER, are so unlike in form to the parent animal that O. F. MUELLER formed distinct genera of them, *Nauplius* and *Amymone;* flat, oval, without tail, with four or six feet very thick, and radiating from the body[1]. Young individuals of *Ergasilus*, *Achtheres*, *Lernæocerá*, present similar forms with four or six feet, according to the observations of NORDMANN[2]. Also the *Cirripedia* present themselves at first under such a form as this, with which, however, that of the young of *Apus* agrees still nearer, that has no abdominal feet, and possesses two pairs of feet, of which the second extends behind the body. [But the larvæ of cirripeds pass through three different stages. In the first the larva, whilst yet in the sac of the parent, is nearly globular, with lateral horns. Posteriorly, on the sternal surface, are two other minute horns pointing backwards. These horns are cases in which the antennæ are being developed. There are three pairs of feet close together in a longitudinal direction, some way apart in a transverse. The first pair has always a single ramus or filament, not articulate in some genera, multiarticulate in others. The abdomen, a little beyond the end of the carapace, terminates in a slightly upturned tail. The mouth is undergoing development on a prominence between the bases of the feet. Towards the second stage, the most conspicuous character is the great elongation of the posterior point of the carapace, whilst the abdomen is prolonged, and has two very long spear-like processes on its outside (*Balanus* GOODSIR), or terminates in a single tapering spinose projection (*Lepas* THOMPSON). In the second stage, the body is prolonged behind the three pairs of limbs and ends in a blunt point, in which, probably, the three posterior pairs of feet, and the abdomen of the larva in the last stage, are developed. The

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DACH'S *Physiologie*, II. s. 248—276, and his *Commentatio de Animalium Crustaceorum generatione*. Regiomonti, 1844, 4to.

[1] DE GEER *Mémoires pour l'Hist. des Ins.* VII. pp. 489—491, Pl. 30, figs. 6, 7, 8; JURINE *Hist. des Monocl.*; RAMDOHR *Beitr. zur Naturgesch. einiger deutschen Monoculusarten*, s. 5, 6, &c.

[2] *Mikrogr. Beiträge*, II. Tab. II. fig. 7, Tab. IV. fig. 7, &c.

mouth is more forward, there are two simple eyes, and the smaller pair of antennæ has disappeared. In the third stage, the larva is much compressed, nearly of the shape of a *Cypris*, and the thorax and limbs hidden and enclosed by the carapace elongated backwards. The part of the head bearing the antennæ is longer and larger than the rest of the body. The antennæ are large and conspicuous, consisting of three segments, of which the second (a sucking disc) is much the largest, the third very small. The antennæ serve for walking, but their principal use is to attach the larva, the attachment being at first voluntary, but soon becoming permanent. There are now two large compound eyes close behind the base of the antennæ. The mouth, as in mature cirripeds, is situated on a slight prominence in front of the thoracic limbs. It is within the carapace, and still rudimentary. The thorax consists of six segments with six pairs of feet, each with a pedicle bearing two arms of two joints. The abdomen is small, but with three segments, of which the second is the longest, and bears two small appendages between which the anus is situated. The bivalve shell and compound eyes of the larva are first moulted: the antennæ not at all. The young cirriped is closely packed within the larva, and there are two rudimentary eyes posterior to the cast-off eyes of the larva. They are situated beneath the integument on the upper part of the stomach[1].] Scarcely less strange are the changes which most of the decapod crustaceans undergo. The early states of short-tailed crustaceans have been frequently recorded in systematic works as distinct genera. Thus the genus *Zoe* Bosc, with large eyes and a long bent beak and a recurved hook on the back, is founded merely on individuals in the first period of life of *Cancer* and *Hyas*[2]. These animals have then a long tail, which only at a later period is bent under towards the breast. But many long-tailed crustaceans also undergo changes of form, ex. gr. *Pagurus*. In *Astacus marinus* the feet are at first provided with a jointed filament, which corresponds to the *flagrum* of the auxiliary jaws. Of all the decapod crustaceans hitherto investigated *Astacus fluviatilis*

[1] DARWIN, *Lepadidæ*, pp. 8—25.

[2] See RATHKE *Reisebemerkungen aus Scandinavien, Neueste Schriften der naturforschenden Gesellsch. zu Danzig*, III. 4tes Heft, 1842, Tab. IV. The discovery of the singular change of forms in *Decapods* was first made by JOHN THOMPSON. RATHKE, relying on his own investigations in *Astacus fluviatilis*, at first doubted, nay, even

presents the smallest changes of form. The Amphipods, on the other hand, come from the egg in a form similar to that of the perfect animal. Many Isopods, also, undergo only slight changes of form; many acquire another pair of feet in addition to those which they had on leaving the egg. The young *Limuli*, according to MILNE EDWARDS, leave the egg without that ensiform appendage or pointed tail which so strikingly distinguishes the full-grown animal.

The crustaceans cast their shell several times. In younger individuals these moultings succeed each other at shorter periods, but in full-grown animals, at least in the decapods, the hard calcareous shell is cast off only once a year. In the River-cray the moulting occurs towards the end of summer. The hard shell begins to loosen itself from the body, which in the meantime is replaced by a new covering situated beneath the former. The animal makes many movements and contortions, until at last a fissure occurs on the back between the abdomen and the large cephalothorax, from which the animal with the fore part of its body and its feet makes its appearance. At last the hinder part of the body divests itself of its old covering. For these observations we are indebted to RÉAUMUR. In the short-tailed crabs the shell splits on each side along the *epimera*. The cast-off shell presents perfectly the form of the living animal[1].

As long as the new shell is still thin and flexible, the crays and crabs are very sensitive. They then conceal themselves in holes, until the new shell has attained sufficient hardness, for which a few days only are requisite.

With the shell the inner coat or the *epithelium* of the stomach is renewed in the crays and crabs. When a new internal tunic of the stomach has been formed the old one is cast off and dissolved in the cavity of the stomach. It has been supposed that the two round calcareous plates which are situated on each side of the

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contested the observations of THOMPSON, but afterwards admitted, with that uprightness which always belongs to the inquirer after truth alone, his mistake respecting this important discovery, and that he had done the English naturalist a wrong; Op. cit. s. 46. See also the observations of DU CANE on the metamorphoses of *Cancer mœnas*, *Annals of nat. Hist.* III. pp. 438—440, Pl. XI.

[1] See RÉAUMUR *Mém. de l'Acad. des Sc.* 1718, p. 263 and foll., COLLINSON *Phil. Trans.* 1746 and 1751, MILNE EDWARDS *Hist. nat. des Crust.* I. pp. 53—57; comp. also RYMER JONES *Animal Kingdom*, 2d edit. 1855, pp. 434—436.

stomach, and are named crab's-eyes (*oculi s. lapides cancrorum*), supplied the matter from which the new shell acquired its hardness. These little stony substances are cast off with the old tunic of the stomach, and being freed from their capsules come into the cavity of the stomach, where they are broken up and partly dissolved. Thus it is possible that the calcareous matter, taken up into the blood, may be useful for the secretion of the hard shell (V. BAER). The part, however, which the crab's-eyes take in the secretion cannot be great, when we compare their weight with that of the calcareous matter in the shell. During the time that the shell is still increasing in hardness, no new crab's-eyes are produced; but only after the shell has attained its greatest hardness is calcareous matter again secreted on the walls of the stomach, and new crab's-eyes again appear. Thus the production of crab's-eyes would appear to be a vicarious secretion; a secretion of such constituents of the blood as, if too abundant, would be injurious to the organism, like the secretion of urine for instance, but with this difference, that the calcareous matter is not set at liberty shortly after its secretion, but remains accumulated for a long time in continuance[1].

The power of restoration or reproduction is very great in this class, so that even feet, amputated or broken off, are replaced by new ones.

We will now speak concisely concerning the organs of animal life. The nervous system consists, as in articulate animals generally, of a cerebral ganglion above or in front of the œsophagus and of a ventral cord, which is formed of a greater or lesser number of ganglia connected together by two filaments. Originally every nervous ganglion consists here, just as we remarked formerly on the ringed worms, of two lateral portions. In some crustaceans this separation of the nervous ganglia persists even in the adult state, as in *Cyamus*, *Talitrus* and *Idotea;* the lateral parts are merely connected by a transverse commissure. In the *Oniscides* the two nervous filaments of the cord lie quite apart from each other, and the ganglia still indicate evidently, by their compressed broad form, their original

[1] Already in the first edition of this Handbook I offered essentially the same opinion respecting the use of the secretion of crab's-eyes, I. bl. 410. Comp. on this subject V. BAER *Ueber die sogenannte Erneuerung des Magens der Krebse* u. s. w. in MUELLER'S *Archiv*, 1834, s. 510—523, and DULK'S chemical investigations, ibid. s. 523—527, but especially ŒSTERLEN, MUELLER'S *Archiv*, 1840, s. 432—440.

condition of pairs. The number of the ganglia is, however, very different, and varies from more than sixty in *apus* to two in the short-tailed ten-footed crustaceans. In *cancer mœnas* a cephalic ganglion is situated above or in front of the œsophagus; from it arise the nerves of the eyes and of the antennæ and neighbouring parts. From the posterior part of this ganglion proceed the two nervous filaments, which form the œsophageal ring, send in the middle a nerve to the upper-jaws, and afterwards unite in the middle of the thorax in a ganglion that is excavated in the centre. This annular ganglion is almost eight times larger than the cephalic ganglion in front of the œsophagus; from its circumference nerves arise that run to the feet and other parts, and, in addition, a single nerve from the back part, that runs in the middle throughout the tail and takes the place of the continuation of the ventral cord, but has no ganglia[1]. In this crab, consequently, the ganglia of the thorax and of the anterior part of the abdomen are represented by a single ganglion, which, however, by the excavation in the middle affords an indication of the lateral divisions. In the genus *Maja*, on the other hand, the union has attained the highest degree, and the large thoracic ganglion has lost the excavation in the middle. Here then there are only two ganglia present, one for the head and one for the thorax and rest of the body[2]. In the long-tailed ten-footed crustaceans, on the contrary, there are different distinct nervous ganglia in the ventral cord, twelve, for example, in the

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[1] CUVIER *Leç. d'Anat. comp.* II. pp. 316, 317.

[2] See AUDOUIN and MILNE EDWARDS *Recherches anat. sur le Syst. nerveux des Crustacés, Ann. des Sc. nat.* XIV. 1828, pp. 76—102, Pl. 2—6.

A fuller description of the nervous system in different families of the crustacea would extend beyond the limits of this Handbook. I will here only add, that in *Limulus* the cephalic and thoracic ganglia coalesce to form a thick elongated nervous ring, which behind the œsophagus is connected by three transverse commissures, and from which backwards a nervous cord arises composed of two closely connected nervous bundles, which in the ventral shield presents inconspicuous gangliform thickenings, and afterwards divides into two lateral portions; each of these strings then terminates in an elongated semilunar ganglion, at the inferior extremity of which two nerves arise that penetrate the caudiform appendage. On the part of the cephalothoracic ring lying in front of the œsophagus there are two conical swellings forwards, from which the two very long optic nerves arise for the two compound eyes situated above on the dorsal shield. These nerves go first forwards and upwards, then bend outwards, and afterwards go backwards to end at the inside of the eyes. Their length is more than one quarter of that of the whole animal, the tail included.

lobster. In the hermit-crab (*Pagurus*) there are, besides the cephalic ganglion, only six ganglia, but the form of the nervous system is in other respects the same[1].

The nervous system existing especially for the organic life, which we have already noticed in insects and spiders, is not wanting in the crustaceans also, however it still in many families remains for the most part or entirely unknown. It has been especially investigated by BRANDT in some *Decapods*, *Stomapods* and *Oniscides*. In crays and in *Squilla* it consists of a single portion and two lateral portions. The single portion arises at the posterior margin of the cerebral ganglion, and has no nervous ganglion that lies in front of the brain as in insects; the lateral portions arise from the œsophageal band that connects the cerebral ganglion with the succeeding ganglionic cord. Distinct ganglia are not present at the origin of the lateral portions, but appear to be fused with the œsophageal band, which indicates a swelling at the point of origin of these lateral nerves. The system of nerves spreads itself over the stomach, presents here one or two ganglia, and finally divides into two branches which are distributed to the liver. In *Porcellio* BRANDT found no single portion of this system, but only two small lateral swellings, situated behind the cerebral ganglion and connected to it by two thin filaments, which send fine branches backwards to the stomach[2].

In most crustaceans, common feeling on account of the hardness of the covering cannot be otherwise than very small. The antennæ, which are often much developed and four in number, are wanting only in few, and, like the whiskers in mammals, may serve for a fine sense of touch even in the dark. In like manner, probably, the jointed filaments of the *cirripedia*, and the filaments on the foot-jaws of the *decapods* and other appendages of the body, may serve for touch in many species. A special organ for taste is not known, but the seat of this sense appears to be in the commencement of the œsophagus[3].

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[1] SWAMMERDAM *Bijbel der Natuur*, bl. 204—206, Tab. XI. fig. IX.; comp. also OWEN, *Catalogue of the physiol. Series of the Museum of the Coll. of Surgeons*, IV. pp. 16, 17, who in other species of the same genus found only four ganglia besides the cerebral ganglion.

[2] Comp. BRANDT in his *Bemerkungen über die Eingeweidenerven der Evertebraten*, cited above (p. 279).

[3] According to MILNE EDWARDS, who appeals to his observations made with

In the river- and sea-crays ROSENTHAL first described and figured an organ as that of smell; which afterwards was also found in some other *decapods*, but is wanting in most species of this order, as well as in the remaining crustaceans. At the base of the middle or innermost antennæ he found a triangular opening beset with hairs, which is the entrance of a triangular cavity lined with a soft membrane, in which nervous branches are distributed[1].

Just as little is known of the organ of hearing in most animals of this class. In the ten-footed crustaceans it was discovered by J. C. FABRICIUS, and MINASI and SCARPA, and others, after him, described and figured it in the river-cray (common cray-fish). At the base of the outermost antennæ is a very hard wart-like excrescence, at whose point is a round opening covered by a tense and very elastic membrane. Behind this membrane is a vesicle filled with fluid, on the walls of which a nerve is distributed that arises with the nerve of the external antennæ from the cerebral ganglion[2].

The compound eyes in crustaceans are formed on the same plan as in insects. BLAINVILLE found in them the vitreous humour, as did JOH. MUELLER after him in the eyes of insects; and his description of the eyes of *Palinurus* agrees with that which we have given above of the compound eyes of insects[3]. In many crustaceans, for instance in the crays, the facettes of the cornea are not hexangular, as in insects, but quadrangular; in some other ten-footed crustaceans,

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AUDOUIN, but which have not been made further known, this sense would seem to be much developed in crustaceans. *Hist. nat des Crust.* I. pp. 112, 113.

[1] See ROSENTHAL in REIL'S *Archiv f. d. Physiol.* X. 1811, s. 433, 436, figs. 1—4. Comp. TREVIRANUS *Biologie*, VI. s. 308, 309. This part is by FARRE considered to be the auditory organ, *Philos. Transact.* 1843, p. 233; comp. however hereon ERICHSON'S report in his *Archiv f. Naturg.* 1844, s. 336, 337, who participates as little in that opinion as I, for my part, am able. [Additional investigations by LEUCKART, *Archiv f. Naturgesch.* 1853, I. s. 255, strongly corroborate FARRE'S conclusions.]

[2] A. SCARPA, *Anatomicæ disquisitiones de Auditu et Olfactu*, Ticini, 1789, folio, pp. 2, 3, Tab. IV. V.; comp. also E. H. WEBER, *de Aure et Auditu hominis et animalium*, Pars I. Lipsiæ, 1820, 4to. pp. 8, 9, Tab. I. figs. 1, 2. The membraneous tube situated in the pedicle belongs to a larger sac placed behind it, BRANDT *Mediz. Zool.* II. s. 64, Tab. XI. fig. 13, *a*, a. In the short-tailed decapods this membrane covering the entrance to the auditory sac is represented as a moveable calcareous plate. See on this little plate and its peculiar arrangement in *Maia*, MILNE EDWARDS *Hist. nat. des Crust.* I. p. 124; on the auditory organs of *Crustacea*, see T. H. HUXLEY *Zoolog. notes and observations* in *Ann. of nat. Hist.* sec. Sér. Vol. VII. 1851, pp. 304—306, Pl. XIV.

[3] DUCROTAY DE BLAINVILLE, *De l'organisation des Animaux*, I. 1822, 8vo. pp. 433, 434.

in the *Stomapods*, &c., they are, however, hexangular. In *Limulus* they are also hexangular, not very regular, and at the outside but little raised. In some crustaceans the eyes are covered with an undivided smooth *cornea*, as in *Apus;* they are compound eyes with a *cornea* without facettes[1]. They make as it were the transition to the clustered eyes, placed in two groups at the side of the head of the *Isopods*, as *Oniscus*, *Idotea*, &c.

The passive organs of motion of crustaceans are the hard coverings of the body and of the limbs, the dermal skeleton. There are also frequently productions of this covering penetrating inwards, horny or hard calcareous projections to which the muscles are attached. In *Limulus* an elongated, rectangular tendinous plate, somewhat excavated on the upper surface, is situated in the inside of the cephalothorax, just as in spiders, in which, at the fore part, are two cylindrical processes that pass into tendons. This part is moved by many muscles, and, with its movements, those of the feet are also connected. The legs of decapods have at every joint a flexor and extensor muscle; those of the first pair or of the so-called claws, in accordance with the greater strength of this pair of limbs, are the most developed. The muscles of the tail in the crays (lobsters, cray-fish, &c.) are divided into two layers; the layer which is situated on the ventral surface, that of the flexor muscles, is more composite and more powerfully developed than the layer which lies towards the back[2].

In art-instincts the crustaceans appear to stand below most insects and arachnids. In them the vegetative or organic life is more developed than the animal.

The geographic distribution of crustaceans has not been hitherto sufficiently investigated, although LATREILLE, and after him espe-

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[1] See JOH. MUELLER in MECKEL'S *Archiv*, 1829, s. 54—59, Tab. III. fig. 15; in *Gammarus pulex*, ibid. figs. 16, 17; in *Branchipus*, H. BURMEISTER in MUELLER'S *Archiv*, 1833, s. 529—534, s. 613, Tab. XIII. figs. 1—4. The conical transparent bodies of the separate divisions of the eye are either attached immediately to the *cornea* or have lenses placed before them, which lie under the *cornea*. See on these peculiarities MUELLER *Handbuch der Physiologie*, II. s. 309. The eyes of Limulus do not however belong to the division in which MUELLER places them. The organs of vision in Crustaceans are largely treated of in R. WAGNER *Lehrb. der vergl. Anat.*, 2te Auflage, 1ter Theil, bearbeitet von DR H. FREY u. DR R. LEUCKART, 1847, s. 202—206.

[2] The tail-muscles of the river-cray are described and figured by CUVIER, *Leçons d'Anat. comp.* I. pp. 423—426, V. Pl. XIV.

cially MILNE EDWARDS, have made copious contributions to it, which however are confined principally to the order of the decapods. With the different peculiarities that have an influence on the distribution of species we are not yet satisfactorily acquainted. The difference of salt-particles in the different seas comes here beyond doubt into consideration, and not the mean temperature alone; the relative depth also, the nature of the coasts, &c. On the whole, the general rule, that animal forms, the genera and species, are more numerous in proportion as we advance from the poles to the equator, has not such an unlimited prevalence for marine animals. In size also and in brilliancy of colour the animals of the polar seas often contest the palm with those of the tropics. Yet the short-tailed ten-footed crustaceans, so rich in species in the seas of the warm regions of our globe, are almost entirely wanting in the neighbourhood of the poles. On the other hand, the northern regions are rich in forms of amphipods, which necessitate the adoption of many distinct genera; so that the colder seas may be regarded as the proper home, the true father-land of these *crustacea*[1].

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[1] H. KROEYER *Naturhistorisk Tidsskrift*, IV. 1842, pp. 141—166. On the geographic distribution of *Crustacea* compare LATREILLE *Mém. du Muséum*, III. 1817, p. 45; or *Mémoires sur divers sujets de l'Hist. nat. des Insectes, de Géographie ancienne*, &c. Paris, 1819, 8vo. p. 174; and especially MILNE EDWARDS, *Ann. des Sc. natur.* 3ec. Série, Tom. X. pp. 129—174.

# SYSTEMATIC ARRANGEMENT OF CRUSTACEA.

## CLASS X.

### CRUSTACEA.

ARTICULATE animals apterous, supplied with articulate feet both thoracic and abdominal, breathing mostly by branchiæ, sometimes by the skin, without stigmata. Heart very often distinct, aortic, situated in the back.

Sexes in most distinct. Animals mostly aquatic.

#### ORDER I. *Pœcilopoda.*

Jaws none. Feet of cephalothorax placed round the mouth, with coxæ very spinose, performing the office of jaws. Abdominal feet resembling semi-orbicular lamellæ, bearing the branchiæ. Two shields, gibbous above, hollowed beneath, horny, hard, one covering the cephalothorax, the other the abdomen.

Family I. *Xiphosura.* (Characters of the order.) Twelve pairs of feet, six attached to the cephalothorax, six to the abdomen. An appendage elongate, acuminate, carinate or gibbous above, plane beneath, adhering by articulation to the posterior part of the abdominal shield, covered by very hard skin.

*Limulus* MUELL. (*Polyphemus* LAM.).

This genus contains only few species, and is the only one in this family. The anterior shield is round forwards, and terminates on each side behind in a point, which extends along the outside of the second shield, which is of less breadth, about as far as its middle. This second or abdominal shield has an irregular hexangular form, and is armed on each side with seven sharp teeth and six moveable

awl-shaped spines between them. The feet of the *Cephalothorax* have a shear-shaped extremity; in the sixth pair the shear is small and almost concealed by four lancet-formed, horny laminæ, that are provided on the outside with a projecting ridge. Below on the abdominal shield are six pairs of leaf-shaped natatory feet, of which the first pair is the largest, and almost entirely covers the rest on the inferior surface; the five following bear on their dorsal surface the gills, which consist of many plates.

Above, on the shield of the *Cephalothorax*, are situated two kidney-shaped compound eyes, very remote from each other, and more forward and near the middle, close to each other, two very small simple eyes of an oval form.

Comp. RANZANI *Osservazioni sul Limulo polifemo* in *Opuscoli scientifici*. Bologna, II. 4to. 1818, pp. 275—285, and VAN DER HOEVEN *Recherches sur l'Hist. natur. et l'Anatomie des Limules. Avec 7 planches.* Leide, 1838, folio.

a) *Abdominal shield with last marginal tooth elongate, with apex in the middle.*

*Feet of the second pair alone monodactylous in males.*

Sp. *Limulus Polyphemus* LATR., GUÉRIN *Iconogr., Crust.* Pl. 34, fig. 1, DESMAREST *Crust.* Pl. 51, VAN DER HOEVEN *Recherch.* Pl. VI. (on the eastern coast of America, especially of N. America).

b) *Abdominal shield with last tooth scarcely longer than the rest, broad, with sharp point marginal.*

* *Feet of the second and third pair monodactylous in males.*

Sp. *Limulus moluccanus, Polyphemus gigas* LAM., RUMPH *Amb. Raritetk.* Tab. XH., VAN DER HOEVEN l. l. Pl. I. The *Cancer perversus* or *Balancas;* this species is found on the shores of the islands of Sunda and Molucca; its Malay name is *Mimie.* The *Limuli* live constantly in pairs, and are also sold in pairs. In the months of July and August they are daily taken in quantities near the roads of Batavia, and brought alive to market. The Malays eat the eggs with avidity, and the flesh also is agreeable to them and to the Chinese. These animals can live more than a day out of water; when laid on the back they are not able to right themselves. The tail is a powerful instrument of defence.

*Limulus longispina* V. D. HOEVEN l. l. Tab. V.; on the coast of Japan.

* * *All the feet in both sexes didactylous.*

Sp. *Limulus rotundicauda* LATR., V. D. HOEVEN l. l. Tab. IV. figs. 1—3. East Indies.

*Note.—Limulus virescens* LATR. The species appears to me doubtful. A single specimen mutilated and imperfect is preserved in the Paris Museum;

I think it is only a monstrous variety of *Limulus moluccanus*. Several fossil species are known from the lithographic formation; see my monograph, Tab. 7.

## Order II. *Ichthyophthira.*

Mouth suctorial. Rostrum tubular, including two mandibles setaceous, acuminate, formed of labium and labrum conjoined, sometimes concealed, or a tubercle instead of haustellum. Anterior feet supplied with hooks or acetabula for fixing the body. Animalcules, in the adult state, adhering parasitically to fishes, often deformed, soft, with segments obsolete. Females supplied with oviferous appendages (external ovaries).

*Fish-lice.* We prefer this name to that of *Parasita*, introduced by Wiegmann, because in the class of insects an order of *Parasitica* had been previously adopted. The animals when young swim freely about, by means of feet with long hairs, and resemble the young animals of *Cyclops*.

Comp. on this order Blainville *Mémoire sur les Lernées, Journal de Physique, de Chim., d'Hist. nat.* &c. Tom. 95, Paris, 1822, pp. 372—380, and pp. 437—447, and by the same the Article *Lernée* in *Dictionnaire des Sciences nat.* xxvi. 1823, pp. 112—130. A. Von Nordmann *Mikrographische Beiträge*, 2tes Heft. Berlin, 1832, 4to. H. Burmeister *Beschreibung einiger Schmarotzerkrebse. Nov. Act. Acad. Cæs. Leop.* xvii. 1835, pp. 269—336; H. Kroeyer *Om Snyltekrebsene, Naturh. Tidsskr.* i. 1837, pp. 172 and foll., pp. 252 and foll., pp. 476 and foll., pp. 605—628, ii. 1838, pp. 8—52, pp. 131—157.

Family II. *Lernæacea* (*Penellina* Burm.) Body in adults not articulate, cylindrical or sacciform. Articulate feet none.

*Lernæa* L. (*Lernæocera* Blainv., V. Nordm.). Body ventricose, mostly incurved. Three or four appendages, branched at the apex or bifid, around the head, for fixing the body.

Sp. *Lernæa branchialis* L., *Encyl. méth., Vers.* Pl. 78, fig. 2, Guérin *Iconogr., Zooph.* Pl. 9, fig. 1; with three branched little horns on the head; the ovisacs are two long tortuous strings; this species fixes itself to the gills of the cod-fish; comp. C. N. (Ozeman) *Vitgezogte Verhandelingin*, ii. 1757, bl. 282 and foll., Pl. 14, iii. bl. 232 and foll., Pl. 23.

There was much doubt formerly respecting the place of these gill-worms in the natural arrangement of the animal kingdom. Cuvier placed them amongst the intestinal worms (*intestinaux cavitaires*, see *R. Ani.* 2e édit. iii. p. 255), as a distinct and anomalous family. The resemblance to some other parasites, which had been referred to the crustacea, caused indeed a

suspicion that the *Lernæa* also might belong to this class (DESMAREST *Cons. gén. s. la Classe des Crust.* p. 344), but it was only after the observations of NORDMANN on the young form of *Lernæocera cyprinacea*, *L. esocina* BURM. (*Mikrogr. Beitr.* II. Tab. VI. figs. 5, 6), that the matter could be regarded as definitively settled. The young animal has three pairs of feet and a single eye in the middle at the anterior part of the body.

*Pennella* OKEN, mob. Head clavate. Two horns elongato-conical at the base of head. Body straight, cylindrical, elongate, subequally thick. Appendages small, disposed in pairs, resembling fins, lanceolate, at the anterior part of body (rudiments of feet). The posterior part of body as though pinnated, with several distinct filaments. External ovaries round, very long.

Sp. *Pennella filosa*, *Pennatula filosa* GM., GUÉRIN *Iconogr., Zooph.* Pl. 9, fig. 3; habit. in fishes of the Mediterranean.

Add genera *Lerneonema* MILNE EDWARDS, and *Penicillus* V. NORDMANN, distinguished from *Pennella* by defect of the posterior pinnated part especially. Genus *Lerneonema* perhaps ought not to be separated from the *Lernææ;* comp. the forms of *Lernæa branchialis* which KROEYER has delineated, I. Pl. 3, fig. 10.

*Sphyrion* CUV.

Family III. *Lernæopoda.* Antennæ small. Feet uncinate, two or more behind the rostrum; natatory feet none.

A. Body affixed by two round arms, grown together from their base throughout their whole length or conjoined at the apex alone, terminated by an adhesive disc.

*Anchorella* CUV. Body produced anteriorly into a cylindrical part like a neck, rugose transversely. A short peduncle from the two arms coalesced at the base of the neck, with adhesive disc at the apex.

Sp. *Anchorella uncinata*, *Lernæa uncinata* MUELL., NORDMANN l.l. Tab. VIII. figs. 8—12. The characters of the genus apply only to the female, as is common in the *Lernææ*. The male, which is much smaller, almost spherical, has a conical rostrum, and two pairs of thick, short hooked feet with one large and two smaller hooklets. See NORDMANN l.l. Tab. X. fig. 1.

[*Pentastoma* RUD. ought to be brought here from the *Entozoa*, according to VAN BENEDEN *Mém. de l'Acad. roy. de Bruxelles*, 1849, and *Ann. d. Sc. nat.* 3ième Sér. *Zool.* Tom. XI. pp. 313—348. See also above, p. 189.]

*Brachiella* CUV. Two arms extended in front of body, conjoined at the apex alone, often very long.

A. Anterior part of body elongate, contracted, resembling a neck.

Genera: *Tracheliastes* NORDM., *Brachiella* NORDM.

B. Anterior part of body oval.

† Abdomen undivided.

Genera: *Lernæopoda* BLAINV., *Basanistes* NORDM.

Sp. *Basanistes Huchonis* V. KOLLAR, *Ann. des Wiener Museums*, I. Tab. X. p. 86. (*Tracheliastes stellifer* KOLL. ibid. Tab. IX. figs. 1—8, seems to belong to genus *Lernæopoda*.)

†† Abdomen divided by segments.

*Achtheres* NORDM.

Sp. *Achtheres percarum* V. NORDMANN l. l. Tab. IV.

B. Body not affixed by two arms.

*Chondracanthus* DE LA ROCHE, *Lernantoma* BLAINV. Upper antennæ subulate, bi- or triarculate, inferior uncinate. Mouth inferior, remote from the anterior part of body, bordered by two hooks, scarcely prominent. Body with various lateral appendages bifid or ramose. External ovaries two. Conical tubercles in many in the mid line of the body, both dorsal and ventral.

Sp. *Chondracanthus La Rochei* CUV. *R. Ani.* Pl. XV. fig. 3 (does not differ perhaps from *Chondrac. gibbosus* KROEYER, I. Pl. 2, fig. 4, pp. 252—257); *Chondracanthus Triglæ* NORDM. l. l. Pl. 9, figs. 1—4; *Lernæa asellina* L. sec. KROEYER, l. l. II. pp. 135, 136;—*Chondracanthis Lophii* RATHKE, *Beitr. zur Fauna Norwegens*. Tab. V. figs. 11—18, &c.

*Clavella* OKEN, KROEYER, (*Habitus* almost of *Peniculus* NORDM.)

*Lernanthropus* BLAINV., *Epachthes* V. NORDM. Superior antennæ sexarticulate. Three pairs of feet behind the rostrum. Cephalothorax separated from abdomen by stricture.

Sp. *Lernanthropus pupa* BURM. l. l. Tab. XXIV. figs. 7—11; *Lernanth. paradoxus, Epachthes paradoxus* NORDM., BURM. ibid. fig. 12.

*Note.*—To this family perhaps is to be referred genus *Staurosonia* WILL, not yet sufficiently known, androgynous in the opinion of the author, parasitic in *Actiniæ;* see ERICHSON'S *Archiv f. Naturgesch.* 1844, pp. 337—343. Tab. X. figs. 1—9. Add genera *Tucca* and *Selius* KROEYER, l. l. I. pp. 476, 479. The last genus is referred by the author to the *Ergasilina*.

*Myzostoma* LEUCKART. (A genus, whose place is uncertain, perhaps to be counted amongst the parasitic crustaceans.)

We have already noticed this genus (p. 575). It was regarded by LOVÉN, who has treated of its structure most exactly, as a form of transition between the Trematodes and the ringed worms. I think that the short jointed feet militate against this disposal of it. The surface beset with vibratile cilia would seem to remove it from the crustaceans, with which however it has the most affinity. The characters which LOVÉN gives to the genus are: *Corpus molle, depressum, discoideum; proboscis retractilis mutica; anus discretus ori oppositus; bothria lateralia opposita; pedes inferi, articulati, hamiferi; genitalia mascula duplicia mutica.* There are different known species of these animalcules, living parasitically on *Comatulæ*, only one or two lines in size, of which one is distinguished by conical *cirri*, twenty in number, at the margin of the disc of the body. See LEUCKART *Zoologische Bruchstücke*, III. 1842, pp. 5—12, LOVÉN, ERICHSON'S *Archiv f. Naturgesch.* 1842, s. 306 foll. or *Ann. des Sc. nat.* 2e Série, XVIII. *Zool.* pp. 291—298.

Family IV. *Ergasilina.* Cephalothorax large. Abdomen articulate, made up of many segments. Two or four antennæ. Mostly four pairs of abdominal feet (natatory).

In these parasites the similarity of form with the genus *Cyclops* is very conspicuous, so that even AUDOUIN and MILNE EDWARDS at first placed the genus *Nicothoë*, discovered by them, with the *Monoculina.*

A. Body elongate. Two filiform receptacles of eggs, at the posterior extremity of body. Uncinate feet behind the rostrum.

*Anthosoma* LEACH. Superior antennæ six-articulate, setaceous; inferior antennæ uncinate. Mouth produced into a rostrum. Cephalothorax oval. Two foliaceous laminæ at the back behind the cephalothorax, and three pairs of laminæ under the abdomen, in place of natatory feet.

Sp. *Anthosoma Smithii* LEACH, *Caligus crassus* ABILDGAARD, *Skrivter of Naturhistorie Selskabet.* III. 3, 1794, p. 49, Tab. V. figs. 1—3, DESMAREST *Cons. gén. s. l. Crust.* Pl. 50, fig. 3; in the mouth and on the gills of sharks.

*Nemesis* ROUX.

Fig. GUÉRIN *Iconogr., Crust.* Pl. 35, fig. 11.

*Dichelesthium* HERM. Anterior antennæ with seven joints, setaceous, reflected backwards; posterior antennæ forcipate, resembling two frontal chelæ, with internal finger moveable. Cephalothorax cordate, truncated anteriorly. Two mandibles denticulate at apex, setaceous, between the folds of rostrum, and two palps

bifid, furnished at the longer apex with double seta. Five pairs of feet, the two first uncinate, the third and fourth with apex bifid, aculeate, the fifth oval, simple. Two small oval appendages at the end of the last segment.

Sp. *Dichelesthium Sturionis* HERM., *Caligus oblongus* ABILDGAARD, l. l. p. 32, Tab. v. figs. 4—11, HERMANN *Mém. aptérol.* Tab. v. figs. 7, 8, RATHKE *Nov. Act. Acad. Cæs. Carol.* Tom. XIX. Part I. 1839, s. 125—153, Tab. XVII.; this elongated parasitic crustacean fixes itself by its two shear-shaped antennæ fast to the branchial arches of the sturgeon.

*Lamproglena* NORDM. Mouth a truncated tubercle. Antennæ four subulate; anterior larger with twelve rings, posterior not articulate. Ocellus single. Two pairs of uncinate feet; four pairs of natatory feet, imperfect, very small.

Sp. *Lamproglena pulchella* NORDM., l. l. Tab. I. MILNE EDWARDS *Hist. des Crust.* Pl. 39, fig. 6.

B. Body oval or broad, depressed, posteriorly attenuated. Two sacciform receptacles of eggs at the base of abdomen. Mouth a truncated tubercle.

*Nicothoë* AUD. and EDW. Cephalothorax in adults divided by a stricture into an anterior cephalic portion, rotundate, small, and a posterior portion very broad; sides of cephalothorax produced into two wings lobed, inflected backwards. Ocelli two. Antennæ two, setaceous, small, ten-jointed. Two pairs of uncinate feet. Four pairs of natatory feet.

Sp. *Nicothoë Astaci* AUDOUIN and EDWARDS, *Ann. des Sc. nat.* IX. 1826, pp. 345—359, Pl. 49, figs. 1—9; this little animal, which, with its two lateral lobes and the two large ovisacs situated behind them, reminds us at first sight of a four-winged insect, a little moth for instance, lives on the gills of the lobster, and undergoes no such changes as most of the parasites and even the *monoculi*, but has merely a different form of the cephalothorax, and two fewer abdominal rings and feet. The male is not yet known, as in other genera of this family. Comp. also KROEYER l. l. II. p. 146, Tab. III. fig. 7, and especially RATHKE *Nov. Act. Acad. Leop. Car.* XX. 1843, pp. 102—106, Tab. v. figs. 1—10, and VAN BENEDEN *Mém. sur le developpement et l'organisation des Nicothoës. Mém. de l'Acad. roy. de Belgique.* Tom. XXIV. av. une pl.

*Bomolochus* NORDM. Antennæ two, with basal joint large, thick, denticulate above, the rest attenuate, setaceous. Feet bifid, setiferous in four pairs.

Sp. *Bomolochus parvulus* V. NORDM. l. l. p. 135;—*Bomol. Belones* BURM. l. l. Tab. XXIV. figs. 1—6.

*Ergasilus* NORDM. Antennæ four; anterior setaceous, sexarticulate, posterior quadriarticulate, large, resembling arms, with last joint incurved, acuminate. Mouth inferior, resembling a conical tubercle in the middle nearly of cephalothorax. Ocellus single, frontal. Four natatory feet divided into two oars. Abdomen attenuated, terminated by double setiferous appendage.

Sp. *Ergasilus Sieboldii* NORDM. l. l. Tab. II.; *Ergasilus gibbus* NORDM. ib. Tab. III. figs. 1—6, &c. To this genus also belongs, as KROEYER justly remarked, the *Lernæa Lavareti* described by OTTO FABRICIUS, *Skrivter of naturh. Selskabet.* III. 2, 1794, p. 21, Tab. III. figs. 1—5.

Family V. *Caligina.* Body suboval, covered with a test above. Cephalothoracic shield large, broader than the rest of body, with anterior margin on each side mostly running out into a transverse process or frontal lamina. Anterior antennæ with two or more, rarely with three joints, broad, short; posterior antennæ biarticulate, uncinate, placed in front of the tubular mouth. Feet of the second pair uncinate. Ovaries external, filiform. Animals mostly not affixed, living parasitically upon the body of marine fishes.

These crustaceans appear to me, more than the other families of this order, to approach the *Xiphosura*, a group that otherwise stands much apart.

A. Lamellose appendages on the back.

* Receptacles of eggs contortuplicate, covered by shield.

*Læmargus* KROEYER. Anterior antennæ triarticulate. Frontal laminæ none. Feet of the fourth, fifth and sixth pairs branchial, with oars large, lamelliform and basal joints minute.

Sp. *Læmargus muricatus* KROEYER l. l. I. pp. 487—501, Tab. V. figs. A—E, MILNE EDWARDS *Hist. d. Crust.* Pl. 39, fig. 2; found on *Orthagoriscus mola.*

*Cecrops* LEACH. Frontal margin of cephalothoracic shield excised in the middle, produced at the sides into a rounded lobe. Anterior antennæ biarticulate. Feet of fourth, fifth and sixth pair with basal joints large, lamellose, branchial and oars short, narrow.

Sp. *Cecrops Latreillii* DESMAREST *Crust.* Pl. 50, fig. 2, GUÉRIN *Iconogr., Crust.* Pl. 35, fig. 8, CUV. *R. Ani. éd. ill., Crust.*, Pl. 78, fig. 4; lives on the Tunny, according to NORDMANN on the gills of *Orthagoriscus mola.*

** Receptacles of eggs straight, exsert, cylindrical.

*Phyllophora* EDW.

*Pandarus* LEACH. Several dorsal shields. Two frontal laminæ.

Sp. *Pandarus Carchariæ* LEACH, BURMEISTER l. l. Tab. 25;—*Pandarus dentatus* MILNE EDWARDS *Hist. d. Crust.* Pl. 38, fig. 19, &c.

*Dinemura* LATR. (*Dinematura* BURM. in part). Two dorsal shields. Two frontal laminæ. Two pairs of palps. Rostrum acuminate, produced. Feet of first pair terminated by two aculeate cirri, of second pair by a strong incurved hook. Feet of third and remaining pairs bifid; basal joints of last pair minute, with large branchial oars.

Sp. *Dinematura ferox* KROEYER l. l. II. pp. 40—45, Tab. 1, fig. 5;—*Dinemura alata, Pandarus alatus* MILNE EDWARDS *Ann. des Sc. nat.* Tome 28, 1833, Pl. 8.

The type of this genus was for LATREILLE the *Caligus productus* of O. F. MUELLER (*Entomostr.* Pl. 21, figs. 3, 4, copied in *Encycl. méth., Crustac., Arachn. et Ins.* Pl. 268, figs. 1, 2). On this species, known only imperfectly, compare KROEYER l. l. pp. 45—47.

B. Lamellæ incumbent on back none. Ocelli two (approximate situated almost in the middle of cephalothorax, yet more towards the anterior margin).

*Caligus* MUELL. Cephalothorax running out anteriorly into two transverse laminæ, produced posteriorly by its outer margin beyond the segment annexed to it, almost resembling a horse-shoe. Furrows in the dorsal surface of cephalothorax forming the figure H. Oviferous filaments exsert.

Add genera: *Euryphorus* NORDM., *Nogagus* LEACH (*Dinematura* BURM. in part), *Trebius* KROEYER.

Sp. *Caligus hippoglossi* KROEYER, *Binoculus piscinus* O. FABR., KROEYER l. l. Tab. VI. fig. 3; on the holybut; this crustacean has been also figured (but hind-foremost) by BASTER *Natuurk. Uitsp.* II. Tab. VIII. fig. IX. *b*, B.—*Caligus curtus* MUELL., *Monoculus piscinus* L. in part, *Caligus Mülleri* LEACH, DESMAR. *Crust.* Pl. 50, fig. 4, on different species of *Gadus.*

*Note.*—*Dinematura gracilis* BURM. is, in the opinion of the learned KROEYER the animal in an earlier state, not yet perfect. He thinks the same of

genus *Chalimus* BURM. containing young *Caligi*. His conjecture has been confirmed by the observations of FR. MUELLER, vid. *Archiv f. Naturgesch.* 1852, s. 91, Tab. IV. figs. 5, 6.

Family VI. *Argulina*. Shell membranous, scutiform, placed upon cephalothorax, extending posteriorly into two wings that receive the body between them. Compound eyes, two. Antennæ four, concealed under cephalothorax, short; the anterior biarticulate, recurved, the posterior quadriarticulate. Rostrum acuminate, situated in front of aperture of mouth. Six pairs of feet, the feet of the first pair being changed in adults into two suctorial acetabula; the feet of the second pair short, with basal joint aculeate, the last eight feet cloven into two oars or pilose cirri. Tail short, bilobed, behind the sixth pair of feet.

*Argulus* MUELL. (Characters of the family).

Sp. *Argulus foliaceus* JURINE, *Monoculus foliaceus* L. *Fauna Suec.* 2044, HERM. *Mém. aptérol.* Tab. VI. fig. 11, KOCH in PANZER u. HERRICH-SCHÆFFER *Ins. Deutschl.* Heft 186, Tab. 20. This little parasitic crustacean lives in fresh water, and attaches itself to fishes (especially *Gasterosteus pungitius*) and to tadpoles. The suckers which had originally the form of fore-feet, are only developed after the fourth moult. Compare on this species the beautiful memoir of JURINE, the son, in the *Ann. du Muséum d'Hist. nat.* VII. 1806, pp. 431—459, Pl. 26, from which the figures of DESMAREST (*Crust.* Pl. 50) are borrowed, and C. VOGT *Beiträge zur Naturgesch. der Schweizer-Crustac. Neue Denkschr. der allg. Schweizerischen Gesellsch. f. d. gesammt. Naturwissensch.* Bd. VII. 1845, pp. 3—16, Tab. I. figs. 1—12.

## ORDER III. *Lophyropoda* LATR. (*Entomostraca* EDWARDS).

Mouth not produced into a rostrum, not suctorial; mandibles suitable for manducation, maxillæ lamellose. Feet never more than ten, natatory, not foliaceous, often cloven into two oars, furnished with setæ or cilia. A single eye or two eyes, sessile.

*Tuft-footed*, or *Oar-footed Crustaceans*. Most of the known species are from fresh-water, and all are of small size; their motions are rapid and frequently interrupted.

Comp. on this order:

MUELL. *Entom.* (*Entomostraca seu Insecta testacea, quæ in Aquis Daniæ et Norvegiæ reperit, descripsit et iconibus illustravit* O. F. MUELLER, Lipsiæ et Hauniæ, 1785, 4to.);—JURINE, *Hist. des Monocles qui se trouvent aux environs de Genève*, 1820, 4to. av. fig.

Family VII. *Copepoda* LATR., EDW. (*Cyclopidæ* BURM.). Body oval, attenuated posteriorly, terminated by two appendages, as if by a forked tail. Maxillæ and foot-jaws various in number, lamellose, setigerous. Antennæ two or (in many) four. Natatory feet mostly eight, cloven into two oars.

This family is very closely allied to *Caligus, Ergasilus,* and some other genera of the preceding order, from which it is distinguished by the absence of the suctorial beak, and especially by the longer antennæ.

A. Eye single, frontal.

*Cyclops* MUELLER (*Monoculus* L. in part).

Add sub-genera: *Cyclopsina, Arpacticus* EDW. and *Notodelphys* ALLMANN.

These little animals are to be met with almost every where in water, even in puddles, gutters, and cisterns of rain-water. The *Cyclopsina alpestris* of C. VOGT was found at a height of 8500 feet in water of the glacier of the Aar; *Neue Denkschr. der allg. Schweizer-Gesellsch. f. d. gesammt. Naturwissench.* VII. pp. 17—19.

The young (comp. above, p. 612) have no tail, and a smaller number of feet. The adult female differs from the male in having two oval sacs which she bears about with her, and which are filled with eggs; some species, instead of two, have only a single sac attached to the middle of the body beneath.

Sp. *Cyclops vulgaris* LEACH, *Monoculus quadricornis* L., ROESEL *Ins.* III. Suppl. Tab. 98, MUELL. *Entom.* Tab. 18, DESMAR. *Crust.* Pl. 53, figs. 1—4; very common in almost all fresh water, so that of a certainty every one has often swallowed this little animal. They may be frozen in the water, and after continuing motionless for days, be restored when the water is thawed, after some hours, from their torpor to their former activity. They are ordinarily thickly beset with *Vorticellæ.* The copulation and impregnation have been illustrated by SIEBOLD'S observations[1].

B. Eyes two.

Genera: *Pontia* EDW., *Cetochilus* ROUSSEL DE VAUZÈME, *Hersilia* PHILIPPI, *Peltidium* PHILIPPI, *Saphirina* THOMPSON, *Canannus* KROEYER (not LEACH).

Comp. MILNE EDWARDS *Ann. des Sc. nat.* Tom. 13, pp. 295—297, Pl. 14;—ROUSSEL DE VAUZÈME *Description de Cetochilus australis, Ann. des*

[1] *Beiträge zur Naturgesch. der wirbellosen Thiere.* Danzig, 1839, 4to. pp. 36—50.

*Sc. nat.* 2e Série, Tom. I. *Zoologie,* pp. 333—338, Pl. 9, PHILIPPI in WIEGMANN'S u. ERICHSON'S *Archiv,* 1839, 1840, 1843, where some other genera are proposed which are here omitted. Comp. LUBBOCK *de novis generibus et specieb. Calanidarum, Ann. of nat. Hist.* sec. Series, Vol. XI. 1853, pp. 25—29, pp. 202—209, XII. pp. 115—124.

Family VIII. *Ostracoda* (*Cypridina* EDW.). Body compressed, with segments indistinct, included in a bivalve shell, with dorsal hinge. Anterior antennæ setaceous; posterior geniculate, pediform. Two pairs of maxillæ; the second pair or foot-jaws with a pectinate or flabelliform appendage at the base. Feet undivided, acuminate towards the extremity, slender, four or six.

The two large jointed appendages, especially useful in swimming, which we have here regarded as posterior antennæ, are by many writers, even by ERICHSON, considered to be the first pair of feet, (placed in front of the mouth). On this supposition these little animals have not two or three, but three or four pairs of feet.

A. Eye single.

*Cypris* MUELL. (Species of *Monoculus* L.). Only two pairs of feet besides the posterior pediform antennæ; feet of the last pair recurved upwards, concealed beneath the shell. Abdomen terminated by a bifurcated tail.

Comp. H. E. STRAUS *Mémoire sur les Cypris, Mém. du Mus. d'Hist. nat.* VII. 1821, pp. 33—61, Pl. I. and S. FISCHER *Abhandlung über das Genus Cypris. Mém. des savants étrangers der Kaiserl. Akad. der Wissensch.* Tom. VII. St Petersburg, 1851.

Sp. *Cypris fusca* STRAUS (*Monoculus conchaceus* L.?), STRAUS l. l. I. figs. 1—16, GUÉRIN *Iconogr., Crust.* Pl. 32, fig. 4, DESMAR. *Crust.* Pl. 55, fig. 1, &c. These animals live in fresh water.

*Cythere* MUELL., *Cytherina* LAM. Three pairs of feet besides the posterior pediform antennæ.

B. Eyes two.

*Cypridina* EDW. [and *Asterope* PHILIPPI].

## ORDER IV. *Cirripedia.*

Crustaceans affixed in the adult period, included in a multivalve shell or coriaceous covering furnished with calcareous points, as though rudiments of shell. Eyes in adults none. Six pairs of

feet, with short fleshy peduncle, and two cirri, multiarticulate, horny. Mouth with mandibles and maxillæ membranoso-horny. Tail round, acuminate, reflected between the feet towards the ventral surface of the animal.

Comp. Poli *Testacea utriusque Siciliæ*, I. pp. 11—39; Cuvier *Mémoires sur les Animaux des Anatifes et des Balanes (Lepas* L.) *et sur leur anatomie; Mém. du Mus. d'Hist. nat.* II. 1815;—G. J. Martin St. Ange *Mémoire sur l'Organisation des Cirripèdes. Avec 2 planches.* Paris, 1835, 4to.;—H. Burmeister *Beiträge zur Geschichte der Rankenfüsser. Mit 2 Kupfert.* Berlin, 1834, 4to.—*Catal. comp. Anat., coll. of Surgeons*, I. Pl. IV. pp. 255—260, Anatomy of *Pentalasmis vitrea* and *Balanus tintinnabulum*. See also the article *Cirrhopoda* by J. Coldstream in Todd's *Cyclopædia*, I. 1836, pp. 683—694: and especially Darwin *Monograph of the Cirripedia (Lepadidæ)*, London, 1851, and *Monograph of the Cirripedia (Balanidæ, Verrucidæ*, &c.), London, 1854.

With Linnæus these animals formed only a single genus (*Lepas*). Lamarck was the first who made of them a distinct class, to which, on account of the filiform arms, he gave the name of *Cirrhipedes* (*cirripedes*[1]). Most writers place them amongst the molluscs, although the resemblance to articulate animals was apparent to many, and Cuvier shewed himself not averse to the opinion that they ought perhaps to be arranged amongst these. The history of their development, however, illustrated by J. V. Thompson[2] and Burmeister, can leave no reasonable doubt that the *cirripedes* belong to the articulate animals, and amongst them do not form a distinct class, but only an order of the crustaceans. The place alone, which we allot them in the series of the crustaceans, may perhaps admit of some doubt, but we think that it ought to be preferred to a position at the end of the crustaceans, which determines nothing respecting their true affinity. According to us the *Cirripedia* have the same relation to the *Daphnidea* and *Phyllopoda* as the *Lernæacea* to the *Copepoda*.

Although the shells differ much in different species, and some of these animals are pedunculated, others not, yet the *cirripeds* have such an agreement in internal and external structure, that we have every reason to admire the sagacity of Linnæus who united them all in a single genus.

The body of these animals is in the adult state inarticulate, although on the dorsal surface, between the different pairs of feet,

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[1] *Philosophie zoologique.* Paris, 1809, I. pp. 314, 315.

[2] *Zoological Researches*, Cork (1830), and *Philos. Transact. for* 1835, pp. 355—358, Pl. VI.

a separation into segments is indicated. It terminates backwards in a thin tail, which earlier writers improperly called the *proboscis*. Along the ventral surface there are six pairs of arms, each of which bears on a short pedicle two long filaments turned inwards, that consist of numerous joints and are beset with hairs. The animals extend these filaments constantly during life, from the opening of the shell and draw them into it again, by which they introduce within the shell the water for respiration and with it their nutriment.

The nervous system consists of a row of six ganglia, or properly pairs of ganglia, connected by two nervous cords. The first ganglion is situated on the short œsophagus; on each side a nervous string descends—a ring being thus formed round the œsophagus—to the second ganglion, which is situated between the first pair of feet.[1] The intestinal canal is straight and very short; it runs along the dorsal surface and terminates at the base of the tail. Through this tail runs the common efferent tube of the two *vasa deferentia* and opens at its point. These animals are bisexual, with some exceptions (see p. 608).

[The prehensile antennæ of the larvæ of Cirripeds in the last form contain the ducts of the cement glands, which may be traced from within the discs of the antennæ to the anterior or lower ends of the incipient ovaria. The gland which secretes the cement appears to be a part of an ovarian tube specially modified. If the base of attachment of a Cirriped be carefully removed, the larval prehensile antennæ, from which the cement always escapes, will be found very near to its extremity. In sessile Cirripeds a new cement gland is formed at every period of growth. DARWIN *Lepadidæ*, 28, 33[1].]

Cirripeds are found in the seas of every region of the world; they attach themselves to rocks, to many marine animals as shell-fish, turtles, whales, to different polyparies, to marine plants, to the hulls of ships, to the floating wreck of vessels that have been lost, as fragments of wood, bottles, &c.

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[1] Our countryman SLABBER, as I lately discovered, was the first who observed and figured the larvæ of *Anatifa*, without however recognising their true nature. See *Natuurk. Verlust.* Tab. VIII. fig. 2, which almost entirely agrees with the figure of THOMPSON *Philos. Trans.* l. l. fig. 5. Perhaps also Pl. VI. fig. 1. of SLABBER is a transitory form of another species.

Family IX. *Balanoidea.* Shell sessile, truncato-conical or tubular, calcareous, open at the apex; calcareous valves at the aperture. Animal conical, sometimes depressed. (Genus *Balanus* BRUG.).

*Sea-Acorns, Sea-Tulips.* The pieces of shell, that form the calcareous tube, shut upon each other with teeth. In some the base is closed by a calcareous plate, in which hollow tubes run from the middle to the margin, which communicate with other tubes in the length of the shell. POLI *Testac. utriusque Siciliæ*, I. Tab. IV. figs. 9, 10. [Branching and inosculating ovarian tubes. DARWIN *Balanidæ* pp. 100, 101.]

[To obviate the extreme confusion of the nomenclature, DARWIN proposes the following names for the external parts of Balanoids.

What is visible externally of sessile cirripeds is composed of *shell* and *operculum*, the operculum being generally seated a little within the orifice of the shell. The shell consists of *basis* or support by which it is attached (membranous or shelly), and of compartments (8—4) occasionally all calcified together. The compartment as the end of the shell where the cirri are exserted is called *carina*, that opposite to it *rostrum*, those on the sides are the three lateral compartments, that next the carina the *carino-lateral*, that next the rostrum *rostro-lateral*, and the middle one simply the *lateral compartment*. These three are rarely present together. Each compartment consists of a wall (*paries*) which always grows downwards and forms the *basal margin*, and is furnished on the two sides with *alæ* or with *radii*, or with an *ala* on one side and a *radius* on the other. The *radii*, not always developed, on the upper part overlap the *alæ*, which usually extend about half-way down the compartment. The *carina* has always two *alæ*. The *carino-lateral* and *lateral* compartments have always an *ala* on the rostral side and a *radius* on the carinal. The *rostro-lateral* (when present) always *radii* on both sides. The rostrum normally has *alæ* on both sides, but very often, when fused with the rostro-lateral compartments, it has *radii* on both sides. The *operculum* consists of a pair of *scuta* and a pair of *terga*, joined to the sheath of the shell by the opercular membrane. On the internal surface of the *scutum* there is almost always a pit for the attachment of the *Adductor scutorum* muscle, and beneath the adductor ridge, often a pit for the *depressor lateralis* muscle.

A slit-like orifice between the opercular valves leads into the sac in which the body is lodged. The valves are two on each side, *tergum* and *scutum*. The *tergum* has three margins, the *scutal*, *basal*, and *carinal*; on the basal margin a spur (*calcar*) depends. The *scutum* has also three margins, the *basal*, *tergal*, and *occludent*, so called from opening and shutting against the opposite valve. DARWIN *Balanidæ*, pp. 3—7.]

*Coronula* BLAINV. Operculum not articulated together, composed of two or four calcareous pieces united by membrane.

*Coronula* LAM., *Diadema* RANZANI. Shell depressed, conical or suborbicular, with very thick walls excavated internally by radiating cells.

Sp. *Coronula diadema* L., BLAINV. *Malacol.* Pl. 86, fig. 4, CUV. *R. An. éd. ill., Mollusq.* Pl. 139, fig. 2, on the Fin-fish, *Balænanoptera*, *Balæna longimana*.

*Tubicinella* LAM. Shell tubular or cylindrical, belted by transverse ribs or rings. Operculum with four valves.

Sp. *Tubicinella balænarum* LAM. *Ann. du Mus.* I. Tab. 30, fig. 1, BLAINV. *Malacol.* Tab. 86, fig. 5, GUÉRIN *Iconogr., Mollusq.* Pl. 38, fig. 14; lives parasitically in the skin of the whale of the southern hemisphere (*Balæna Mysticetus antarctica*).

*Balanus* BRUG. (exclusive of some species), LAM. Shell conical, composed of six laminæ or valves. Operculum articulated, subvertical, consisting of four valves.

Sp. *Balanus sulcatus* LAM., *Lepas balanus* L., BASTER *Natuurk. Uitsp.* I. Tab. XII. figs. 7—10; *Balanus miser* LAM., *Encycl. méth. Vers.* Pl. 64, fig. 4, &c.

*Acasta* LEACH.

*Creusia* LEACH.

*Pyrgoma* SAVIGNY.

*Note.*—On this and some other genera, proposed by RANZANI[1] and others, compare MILNE EDWARDS in the new edition of LAMARCK'S *Hist. nat. des Anim. s. Vertèbres*, V. 1838, pp. 669—672.

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[1] *Observationi su i Balani; Opuscoli scientifice di Bologna* I. 1817, pp. 195—202, pp. 269—276, II. 1818, pp. 63—93.

Family X. *Lepadicea* (BLAINV.) s. *Anatiferæ*. Animal suspended by a peduncle cylindrical, flexible. Shell mostly compressed or involucrum coriaceous. (Genus *Anatifa* BRUG.).

[These Cirripeds consist of a *capitulum*, much flattened, and a pedicle of various length. The capitulum is generally formed of five or more valves, connected together by narrow or broad stripes of membrane: sometimes the valves are rudimental or absent, when the whole consists of membrane. Of the valves the *scuta* are the most persistent, then the *terga*, then the *carina*, the *rostrum* and *latera* occur only in a few (*Pollicipes*). The *scuta* and *terga* are always considerably larger than the other valves. Within the *capitulum* is the sac which encloses the animal's body. The peduncle is usually flattened, sometimes quite cylindrical. Its corium is very thick, and in those genera having numerous valves, scales are found at its connexion with the capitulum placed in whorls. The peduncle is lined by three layers of muscles, running from its bottom to the base of the capitulum: and the cement ducts may be traced upon them on each side until they expand into the two cement glands, and which are connected with the ovarian tubes. The cement escapes through the larval prehensile antennæ, which may be always found quite close to the end of the peduncle if it be carefully removed from the surface of attachment. Vid. DARWIN *Lepadidæ*, pp. 28—37. See also above, pp. 608, 609.]

*Tetralasmis* CUV., *Ibla* GRAY. Peduncle short, hirsute. Shell with four valves, two dorsal long, narrow, and two ventral triangular.

Sp. *Tetralasmis hirsutus* CUV., *Anatifa quadrivalvis* CUVIER *Mém. sur les Anatifes*, fig. 14, GUÉRIN *Iconogr., Moll.* Pl. 37, fig. 7.

*Anatifa* LAM. (Species from genus *Anatifa* BRUG.). Peduncle smooth, resembling intestine, elongate in some. Shell with five valves; the single dorsal valve narrow, falciform.

*Goose-mussel.* The four pieces of shell in pairs are, as in the preceding genus, to be compared with the opercular plates of the *Balani*; the single piece of shell along the back of the animal *carina* corresponds to the calcareous tube, and the stem is as it were an elongation of the basal piece of the tube of the last-named animals.

Sp. *Anatifa lævis* LAM., *Lepas anatifera* L., BLAINV. *Malacol.* Pl. 86, fig. 3, GUÉRIN *Iconogr.* l. l. fig. 1; this species is often thrown on our shores, especially in the winter months. In different districts of the north, a fable is current that a species of goose (*Anas bernicla*) has its origin from

this crustacean; from this ridiculous popular fancy the specific name *goose*-mussel is derived.

*Pollicipes* LEACH (and *Scalpellum* ejusd.), *Polylepas* BLAINV. Peduncle rough, squamose. Shell compressed at the sides, with valves subcontinuous, unequal, thirteen or more.

Sp. *Pollicipes scalpellum* LAM., *Lepas scalpellum* L., GUÉRIN *Iconogr.* l. l. fig. 4;—*Pollic. mitella, Lepas mitella* L., RUMPH. *Amb. Rariteitkarn.* Tab. 47, fig. M, GUÉRIN l. l. fig. 3, &c.

*Gymnolepas* BLAINV. *Conchoderma* OLFERS. Mantle naked, without valves, or with rudiments of valves, remote from each other.

*Cineras* LEACH, LAM. Calcareous pieces five distinct, joined by membrane, small, with one dorsal, two above the aperture of mantle, two others below that aperture.

Sp. *Cineras vittata* LEACH, *Lepas coriacea* POLI *Testac.* I. Tab. VI. fig. 20, GUÉRIN *Iconogr.* l. l. fig. 5; in the Mediterranean sea.

*Otion* LEACH. Two lunated valves at the margin of the aperture towards the peduncle. Body with two tubular ear-like appendages pervious at the apex.

Sp. *Otion Cuvierii, Lepas aurita* L., POLI l. l. fig. 21, GUÉRIN *Iconogr.* l. l. fig. 6.

*Alepas* RANG. Mantle without any calcareous pieces, subpellucid, continuous with peduncle.

Sp. *Alepas fasciculata* LESSON, *Anatife jaune sans coquille* MARTIN SAINT-ANGE *Mém. sur les Cirripèdes*, Tab. I. GUÉRIN *Iconogr.* l. l. fig. 8, *Alepas squalicola* LOVÉN, *öfversigt of konigl. vet. Akad. Förhardlingar.* 1844, pp. 192, 193, Tab. III. (in this species, that lives parasitically on sharks, the feet also are soft, and without bristles).

*Note.*—On the fossil species, which are chiefly found in chalk strata, of *Anatifa* and *Pollicipes* comp. STEENSTRUP in KROEYER'S *Tidskrift* I. 1837, pp. 358—366, II. 1839, pp. 396—415, and on the fossil *Lepadidæ* of Great Britain, C. DARWIN'S *Monograph*, 1851, printed for the Palæontographical Society.

[From the investigations of DARWIN, recorded in his two admirable memoirs so often cited, we learn that his subclass of Cirripeds contains forms that differ greatly from those of the *Balanoidea* and *Lepadicea* and are much less perfect in their organisation. He divides the Cirripeds into three orders—the *Thoracica, Abdominalia*, and *Apodes*, the limbs or cirri being thoracic in the first, abdominal in the second, and entirely absent in the third. In the

*Thoracica* three families are included—the *Balanidæ* or sessile Cirripeds, the *Verrucidæ*, (the genus *Clysia* LEACH, *Crèusia* LAM., *Verruca* SCHUMACHER, SCHUM. *Essai d'un nouveau Système des Habitations des Vers testacès*, 1817. Copenhav.), remarkable for their quite asymmetrical shell, and the *Lepadidæ* or pedunculated Cirripeds. In the second order of *Abdominalia* the seventh or last cephalic segment is quite distinct, and bears rudimentary organs answering to the first pair of foot-jaws in ordinary crustaceans, of which organs, and of the segments supporting them, there is no trace in the *Thoracica;* the seven succeeding thoracic segments are destitute of any appendages; but the three segments of the abdomen bear three pairs of cirri. In the metamorphosis all the first changes are merely indicated by changes of form in the egg-like larva, without the development of distinct organs, and the last or pupal condition, which is attained within the sac of the parent, is very peculiar from the entire absence of rotatory limbs. There is only one genus *Cryptophialus* DARWIN, and one known species *Cryp. minutus* DARW., *Balanidæ*, p. 566, Tab. 23, 24. The third order *Apoda* is the most peculiar of all, it resembles the larva or maggot of a fly, the carapace is reduced to two separate threads for attachment. The last cephalic, the seven thoracic, and the three abdominal segments are all destitute of appendages. The single known species, *Proteolepas bivincta*, is parasitic within the sac of *Alepas cornuta*, DARWIN *Lepadidæ*, p. 165, Tab. 3, fig. 6. See DARWIN *Balanidæ*, pp. 20—22.]

ORDER V. *Cladocera* LATR.

Body compressed, included in a horny shell, divided into two parts by a dorsal fold, without hinge. Head free, produced below, terminating in a species of rostrum. Two small antennæ at the apex and two larger at the base of head, split into two or three branches. Feet foliaceous, with four or five pairs. Abdomen terminated posteriorly by two setaceous appendages.

Family XI. *Daphnidea* STRAUS. The characters of the order are those of the single family. Single compound eye. Larger antennæ ramose, serving like oars for swimming. Ova in females situated on the back in a space between the shell and the segments of the thorax.

*Polyphemus* MUELL., *Cephaloculus* LAM. Eye single, large, occupying almost the whole head. Larger antennæ bifid. Feet eight, exsert from shell. Tail reflected, bisetose at the apex.

Sp. *Polyphemus oculus* MUELL., (*Polyphemus pediculus* L. ?) DE GEER *Mém. s. l. Ins.* VII. Pl. 28, figs. 9, 10, MUELL. *Entom.* Tab. XX. figs. 1—5, DESMAR. *Crust.* Pl. 54, figs. 1, 2, KOCH, HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 187, Tab. 2.

*Evadne* LOVÉN.

Compare S. L. LOVÉN *Evadne Nordmanni, ein bisher unbekanntes Entomostracon,* in WIEGMANN'S *Archiv f. Naturgesch.* 1838, pp. 143—166.

*Daphnia* MUELL. (and *Lynceus* ejusd.). Feet ten, included in shell, the eight anterior foliaceous, ciliated. Larger antennæ bifid, with branches having from two to four joints.

Sp. *Daphnia pulex* LATR., *Monoculus pulex* L., SWAMMERDAM *Bibl. nat.* Tab. 31, figs. 1—III, MUELL. *Entomostr.* Tab. XII. figs. 4—7, DESMAREST *Crust.* Pl. 54, figs. 3—5 (borrowed from the figures of STRAUS); *the branched water-flea.* This species is reddish, especially in spring, and from its abundance may give a red colour to the water, or cause an apparent change of it into blood, of which SWAMMERDAM adduces a remarkable example, bl. 89, 90.

In the genus *Lynceus* MUELL. there is a black spot in front of the eye; the antennæ are usually very short. To these belongs *Lynceus sphæricus,* &c. EDWARDS counts some of the species of *Lynceus* MUELL. in the genus *Daphnia.* BAIRD adopts here different sub-genera, as *Macrothrix, Eurycerus, Chydorus* LEACH, *Camptocercus, Acroperus, Alona, Pleuroxus, Peracantha* (*Ann. and Magaz. of Nat. Hist.* Vol. XI. pp. 81—95, 1843), *Bosmina* (ibid. Vol. XVII. 1846, pp. 410—413).

Compare on this genus H. E. STRAUS *Mémoires sur les Daphnia, Mém. du Muséum,* V. 1818, pp. 380—425, Pl. 29; VI. 1820, pp. 149—162; also W. BAIRD, *Annals and Magaz. of Nat. Hist.* I. 1838, pp. 245—256. Pl. IX.

*Acanthocercus* SCHOEDL.

Compare J. ED. SCHOEDLER, *Ueber Acanthocercus rigidus, ein bisher unbekanntes Entomostracon.* ERICHSON'S *Arch. f. Naturgesch.* 1846, s. 301—374, Taf. XI. XII.

Genus *Latona* STRAUS, with bifid antennæ, differs from *Daphnia.*

Sp. *Daphnia setifera* MUELL.

## ORDER VI. *Phyllopoda.*

Feet lamellose, branchial, in eight pairs or more: in some, other natatory feet besides inserted behind the former. Two compound eyes.

Family XII. *Branchiopoda.* Body naked, without shell. Eleven pairs of branchial feet. Two eyes petiolated and a frontal ocellus sessile.

A. E. GRUBE, *Bemerkungen über die Phyllopoden, nebst eine Uebersicht ihrer Gattungen und Arten. Mit 4 Kupfertafeln.* Berlin, 1853, 8vo.

LIEVIN, *Die Branchiopoden der Danziger Gegend. Mit* XI *Tafeln in Steindruck.* Danzig, 1848, 4to.

*Branchipus* SCHÆFFER (in part), LATR., (*Branchiopoda* LATR. previously, LAM.). Abdomen caudiform, long, composed of from six to nine segments, bilobed at the apex, or terminated by two pinnæ. Antennæ four, the superior filiform or setaceous, the inferior incurved, resembling horns, directed downwards.

Sp. *Branchipus stagnalis, Cancer stagnalis* L., J. C. SCHÆFFER *Der fisch-förmige Kiefenfuss, m. einer color. Kupferpl.* Regensburg, 1754, 4to. Ejusd. *Elem. entomol.* Tab. 29, figs. 6, 7, *Encycl. méth. Crustac.* Pl. 336, figs. 4—16, —*Branchipus paludosus* LATR., *Chirocephalus diaphanus* PRÉVOST, DESMAR. *Crust.* Pl. 56, figs. 2—5, GUÉRIN *Iconogr., Crust.* Pl. 33, fig. 3. These animals resemble in some degree the larva of the common ephemera, so that LINNÆUS himself was in doubt whether *Cancer stagnalis* was not such a larva. They live in stagnant fresh water, and in pools formed by summer-showers in roads. The young animals do not at first resemble the old ones, have a short oval body, and besides the antennæ, two pairs of jointed appendages, of which the first pair consists of two long and strongly developed rowing feet, curved, bent backward, and beset with many hairs; these parts afterwards change into the posterior antennæ or horns of the head; the abdomen lengthens, and only after repeated moultings acquires feet, which at first are less numerous because the posterior appear later than the anterior.

*Artemia* LEACH, *Artemisus* LAM.

Sp. *Artemia salina, Cancer salinus* L., RACKET *Trans. of the Linn. Society,* XI. Tab. XIV. figs. 8—10; N. JOLY *Histoire d'un petit crustacé, Artemia salina* LEACH, &c. Montpelier, 1840, 4to. This little animal lives in fresh water at Lymington, Montpelier, &c.; it was named by the English author *Brineworm,* and is almost ½ inch long.—*Branchipus Mulhauseni* FISCHER, *Artemia salina* RATHKE, *Fauna der Krym, Mém. des Sav. étrangers presentés à l'Acad. imp. des Sc. de St. Petersbourg,* III. 1837, VI. figs. 14—21; in a salt-water lake of the Crimea, and probably also in Siberia.

*Eubimene* LATR. Abdomen short, almost semi-globose.

Compare LATREILLE in CUV. *R. Ani.* III. p. 168, 2e édit. IV. p. 178.

Family XIII. *Aspidephora.* Body either covered by a clypeiform or inclosed in a bivalve shell.

A. *Eyes petiolate.*

*Nebalia* LEACH. Shell compressed, plicated at the back, descending by the sides of the body, covering head, thorax and part of

abdomen; a moveable appendage, resembling a rostrum at the anterior part of the shell. Four antennæ, terminated by a long many-jointed seta, serving for swimming. Natatory feet bifid, in different number behind four pairs of branchial feet, lamellose.

Sp. *Nebalia Herbstii, Cancer bipes* O. FABR., *Faun. Groenl.* fig. 2, p. 246;—*Nebalia Geoffroy* EDWARDS, *Ann. des Sc. natur.* Tom. XIII. 1828, pp. 297—300, Pl. XV. GUÉRIN *Iconogr., Crust.* Pl. 32, fig. 2. Compare also EDWARDS *Ann. des Sc. nat.* 2e Série, III. pp. 300—311. To this genus belongs also *Monoculus rostratus* MONTAGU (*Transact. of the Linn. Soc.* XI. fig. 5), *Nebalia Montagui* THOMPSON.

B. Eyes sessile.

*Limnadia* BRONGNIART. Body inclosed in a bivalve, oval, compressed shell. Antennæ four, anterior short, undivided, posterior and exterior large, with a cylindrical peduncle and two branches setaceous, multiarticulate. Feet (eighteen to twenty-seven pairs) lamellose, bifid, with a filament at the base recurrent or ascending towards the back. Last segment of body terminated by two diverging filaments.

Sp. *Limnadia Hermanni* AD. BRONGNIART, *Mém. du Mus.* VI. 1820, pp. 83—92, *Daphnia gigas* HERM., *Mém. aptérol.* Tab. V. figs. 4, 5, KOCH in HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 185, Tab. 10;—*Limn. mauritiana* GUÉRIN, *Magas. Zool.* 1837, Cl. VII. Pl. 21, figs. 1—11, *Iconogr., Crust.* Pl. 33, fig. 2.

Compare also J. KRYNICKI, *Des Limnadies* in the *Bullet. de la Soc. imp. des Natural. de Moscou*, II. 1830, pp. 173—182, Pl. VII. *Limnadia tetracera.* This writer found males, and observed the copulation. BRONGNIART observed only females.

*Estheria* RUEPPELL.

Sp. *Estheria dahalacensis* RUEPP., STRAUS DURCKHEIM, *Museum Senckenbergian.* II. 1837, pp. 117—128, Tab. VII.

*Apus* SCHÆFF., *Limulus* MUELL., LAM. Shell produced from head over thorax and a great part of abdomen, clypeiform, thin, deeply emarginate posteriorly. Eyes two, approximate, including an ocelliform point. Two inferior antennæ very short, styliform, biarticulate. Mandibles strong, gibbous externally, with internal margin straight, denticulate. Two pairs of maxillæ. Sixty pairs of feet; first pair incurved, filiform, with three very long setæ exsert beyond the shell, multiarticulate; remaining feet lamellose. Six last segments destitute of feet; two setæ at the last segment long, multiarticulate.

These animals, on a first impression, seem to have some conformity with the genus *Limulus*, although they are much smaller. They differ however from these greatly, as well in their oral organs, which are formed on the type of insects (compare SAVIGNY *Mém. sur les Ani. s. v.* I. pp. 63, 64, Pl. VII.) as in internal structure. They undergo, as already stated in p. 613, a metamorphosis resembling that of *Branchipus*. They are found in fresh water, canals, fish-ponds, and pools formed by abundant rain.

Compare G. C. SCHÆFFER *Der Krebsartige kiefenfuss, mit 7 illum. Kupfertafeln.* Regensburg 1756. 4to, and E. G. ZADDACH, *De Apodis cancriformis Anatome et Historia evolutionis, acced. tabulæ 4 lithogr.* Bonnæ, 1841, 4to.

Sp. *Apus cancriformis* LATR., SCHÆFFER *Monogr. cit., Elem. entom.* Tab. 29, figs. I. II.; F. H. LOSCHGE *Naturforscher*, Tom. XIX. 1783, Tab. III.; GUÉRIN *Iconogr., Crust.* Pl. 34, fig. 2.

Another smaller species has an elongate oval plate between the two filaments of the tail, and forms the genus *Lepidurus* LEACH; it is the *Apus productus* LATR., *Monoculus apus* L., DESMAR. *Crust.* Pl. 52, fig. 2; GUÉRIN, II. fig. 3.

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## Appendix to the PHYLLOPODA.

### *Trilobites* or *Palæades.*

Fossil crustaceans. Shield cephalic, rounded anteriorly, mostly supplied with two lateral eyes oval or reniform, often extending posteriorly on each side into a horned point. Segments of thorax and abdomen transverse, different in number, mostly divided by two longitudinal furrows into three convex lobes. The posterior part of abdomen often undivided (*pygidium*). Body of some contractile into a ball.

Very different opinions were entertained formerly respecting the *Trilobites*. Because the transverse segments in these fossil individuals offered some resemblance to *Chiton*, LATREILLE was really of opinion that they ought to be placed in the neighbourhood of this genus. *Mém. du Muséum*, VII. pp. 22—32, *Règne Ani.* 2e édit. IV. pp. 202, 203, whilst he had previously considered them to be a transitional form between the *crustacea* and the *myriapoda*, between *Limulus* and *Glomeris* (*R. Ani.* 1ère édit. III. pp. 150, 151). That these remains belong to the type of the articulates was already apparent to LINNÆUS, who collected the few petrifactions of this division known to him under the name of *Entomolithus paradoxus*. WAHLENBERG in 1818 (*Act. Societ. Reg. Scient. Ups.* Vol. VIII. p. 1), in a memoir in which new species were also described, illustrated

and confirmed this opinion of LINNÆUS. He thought that the *Trilobites* had the closest affinity with *Limulus*. This opinion was also adopted by some other writers, although to me the affinity with *Limulus* appears certainly not to be greater, or even not so great, as with *Branchipus* or *Apus*. The *Trilobites* were probably gigantic *Phyllopoda* which peopled the seas of a former world. The resemblance to the *Isopoda* appears to me to be rather an analogy than a real affinity. That the *Trilobites* were possessed of small natatory feet which were soft, and so lost in the petrifying, is very probable[1]. They are all confined to the oldest mountain-strata, in which petrifactions occur, which preceded the coal-formation, and are found especially in the Silurian formation of MURCHISON and other modern geologists.

Compare on this division amongst others: A. BRONGNIART in the work published by him and DESMAREST, *Hist. natur. des Crustacés fossiles*, Paris, 1822, 4to. pp. 1—65;—J. W. DALMAN *Ueber die Palæaden oder die sogenannten Trilobiten; aus dem Schwedischen von* FR. ENGELHART. *Mit 6 Kupfert.* Nurnberg 1828, 4to;—H. BURMEISTER *Die organisation der Trilobiten, aus ihren lebendigen Verwandten entwickelt. Mit 6 Kupfertafeln.* Berlin, 1843, 4to;—E. BEYRICH *Ueber einige böhmische Trilobiten.* Berlin, 1845, 1846, 2 Stücke, 4to. m. Kupfert.;—DR EMMRICH *Ueber die Trilobiten* in V. LEONHARD u. BRONN, *Jahrbuch für Mineralogie* 1845, s. 18—62; and especially the admirable work of JOACHIM BARRANDE, with a great number of beautiful plates, *Système Silurien du Centre de la Bohème*, 1ère partie; *Recherches paléontologiques*, Vol. I. 1852. Prague et Paris, 4to.

Some *Trilobites* did not roll their body up. To these belong the genera:

*Trinucleus* MURCHISON (*Cryptolithus*), *Ogygia* BRONGN., *Ceraunes* GREEN, *Arges* GOLDF., *Brontes* GOLDF., *Paradoxides* BRONGN., *Olenus* DALM., BURM., *Conocephalus* ZENKER, *Ellipsocephalus* ZENKER, *Harpes* GOLDF.

Sp. *Olinus Tessini* DALM., *Entomolithus paradoxus* LINN., *Mus. Tessinianum* Holmiæ, 1753, fol. Tab. III. fig. 1, pp. 98, 99, DALM. l. l. Tab. VI. fig. 3.

Other *Trilobites* were able to roll themselves up, like *Glomeris* and some *Oniscides*, and to bring the shield of the tail to that of the head. They had, as it seems, a harder shell, and commonly a larger tail-shield. To these belong:

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[1] It was principally because these feet are not known that LATREILLE arrived at the singular opinion concerning the agreement with *Chiton;* he says of his own accord, that under this point of view he must consider the eyes, which are observed in many Trilobites, to be tubercles.

*Calymene* BRONGN., *Homalonotus* KOENIG, *Asaphus* BRONGN. (Add some other genera omitted here).

Sp. *Calymene Blumenbachii* BRONGN., TORRUBIA *Apparato para la Historia natural Española*, Madrid, 1754, fol. Tab. III. fig. 4, p. 83; BLUMENBACH *Abb. naturhistor. Gegenstände*, No. 50, DALM. l. l. Tab. 1. figs. 2, 3, *a–c*, &c.

*Note.*—On these and some other genera, more numerous than seems to be necessary, consult the authors quoted; on *Battus* DALM. see especially BEYRICH, I. s. 44. Other genera, *Eurypterus* DEKAY, *Cytherina* HISINGER, seem scarcely to have their place here.

## ORDER VII. *Isopoda.*

Head distinct from the segment bearing the first pair of feet. Trunk divided into seven rings sustaining seven pairs of feet. Feet of trunk all undivided. Tail with segments different in number up to seven, supplied beneath with branchial foliaceous feet. Mandibles and maxillæ mostly distinct. Antennæ four, the lateral at least setaceous. Eyes two, sessile, in most composed of a cluster of ocelli, in others compound.

Family XIV. *Epicarides* or *Bopyrina.* Antennæ very short, imperfect, resembling tentacles. Feet short, incurved, hooked. Parasitic animalcules; females much larger than males, broad, with eyes none or indistinct.

*Bopyrus* LATR. Five pairs of abdominal feet lamellose, concealed under abdomen.

Compare H. RATHKE, *De Bopyro et Nereide commentationes anatomico-physiologicæ duæ. Cum tab.* iii *æneis.* Rigæ et Dorpati, 1737, 4to.

The species hitherto known of this and the following genus live parasitically on *Palæmones* (*Carides*), in the gill-cavity or on the ventral surface of these crustaceans (*Bopyrus abdominalis* KROEYER on *Hippolyte*). The sexual difference is in these animals when adult very great. The male is elongate, narrow, and keeps himself hidden between the gill-plates of the female. The female is much larger, broader and asymmetrical. There are seven pairs of short feet attached to the trunk, and five pairs of gill-leaves (abdominal feet) on the abdomen, which is divided into six rings, of which the hindmost is very small, and bears no gills. The young animals of each sex are on the contrary of similar form, with four pairs of feet and long posterior antennæ (RATHKE, *Zur Morphologie, Reisebemerkungen aus Taurien*, s. 47—51).

Sp. *Bopyrus squillarum* LATR., *Monoculus Crangorum* FABR., LATREILLE *Gen. Crust. et Ins.* Tab. II. fig. 4, fem., GUÉRIN *Iconogr., Crust.* Pl. 29, fig. 1, RATHKE *de Bopyro*, Tab. I. This little animal (the male is at most 1½ lines long, the female 5 lines) lives under the dorsal shield on the gills of *Palæmones;* on the *Crangones*, so nearly allied to them, and often living in the same situation, this *Bopyrus* as it seems does not occur (RATHKE). The fishermen think that these parasites are young soles (*Pleuronectes solea* L.)

*Phryxus* RATHKE. Branchiæ exsert, bilobed, in four pairs.

Sp. *Phryxus Hippolytes* RATHKE *Beiträge zur Fauna Norwegens*, Tab. II. figs. 1—10, pp. 40—56. This little animal, not different from *Bopyrus abdominalis* KROEYER (*Tidsskrift*, III. 1840, pp. 102—112, 289—299, Tab. I. II.) keeps to the ventral surface of *Hippolyte*. The full-grown female has on one side only a single foot which is attached to the first segment, whilst on the other side, as is usual, seven feet are found.—*Phryxus crangonis* RATHKE, ibid. Tab. I, figs. 13—15, Tab. II. figs. 11, 12.

*Ione* LATR. Branchial feet in six pairs, exsert, filiform, arborescent in female.

Sp. *Oniscus thoracicus* MONTAGU, *Transac. of the Linn. Soc.* Vol. IX. p. 103, Pl. 3, figs. 3, 4, DESMAR. *Crust.* Pl. 46, fig. 10, GUÉRIN *Iconogr., Crust.* Pl. 46, figs. 1, 2; compare also AUDOUIN and MILNE EDWARDS *Ann. des Sc. nat.* Tom. IX., EDWARDS *Hist. nat. des Crust.* Pl. 33, figs. 14, 15. This species lives on the gills of *Callianassa subterranea.*

*Kepon* DUVERNOY (*Cepon*). Feet unarmed, with last joint subdilated. Abdominal feet with pinnated branchiæ.

Sp. *Cepon typus*, DUVERNOY *Ann. des Sc. natur.* 2e Série, Tom. XV. 1841, *Zoolog.* pp. 110—122, Pl. 4, B, figs. 1—11.

Family XV. *Cymothoadea.* Head small. Mandibles furnished with a large palp. Feet of trunk in seven pairs, either all or the anterior terminated by a hook incurved and moveable. Body oval, depressed. Posterior part of abdomen or tail composed of from three to six segments, with last segment (*pygidium*) large, scutiform. Feet of caudal segments lamellose; feet of last pair terminated by two oars or oval styles, exsert on each side near the pygidium.

Comp. the article *Cymothoadées* by W. E. LEACH, *Dictionnaire des Sciences natur.* XII. pp. 338—354.

*Cymothoa* FABR. Antennæ short, inserted under the exsert frons. Eyes two, lateral, situated at the margin of head. Seven pairs of feet; feet terminated by a hook incurved and moveable, bent and hidden under the trunk.

*Urozeuctus* (*Ourozeuktes* Edw.). Tail undivided, with segments coalesced.

*Cymothoa* nob. Tail composed of six segments, distinct, moveable.

Sub-genera: *Cymothoa* Leach, *Livoneca* Leach, *Anilocra* Leach, Edw. (*Anilocra* and *Canolira* Leach), *Nerocila* Leach, Edw. Comp. W. E. Leach, l. l.

These animals live parasitically on different fishes. The young animals have a larger head, the eyes more conspicuous, a pair of feet less on the trunk, and a long abdomen. See Milne Edwards *Ann. des Sc. nat.*, sec. Série, Tom. III, *Zool.* Pl. 14, fig. 3.

Sp. *Cymothoa œstrum* Leach (*Oniscus œstrum* L. in part), Desmar. *Crust.* Pl. 47, figs. 6, 7, Cuv. *R. Ani. éd. ill., Crust.* Pl. 65, fig. 1; in the Baltic; —*Cymothoa Banksii* Leach, Milne Edwards *Ann. des Sc. nat.* l. l. figs. 1, 2 (copied in Guérin *Iconogr., Crust.* Pl. 29, fig. 2, under the name of *Cymoth. trigonocephala*), from the Cape of Good Hope, &c.

*Alitropus* Edw. Antennæ not covered at the base, setaceous. All the feet of trunk slender, terminated by a hook. Eyes two, marginal.

Sp. *Alitropus typus* Milne Edwards, *Hist. nat. des Crust.* Pl. 33, fig. 1; from the bay of Bengal.

*Ægа* Leach. Antennæ not covered at the base, anterior with basal joints broad, plane and apex setaceous, multiarticulate.

Sub-genera: *Pterelas* Guérin, *Rocinela* Leach; with eyes large, contiguous, or confluent anteriorly.

Comp. Guérin *Magasin de Zool.* 1836, *Crust.* Pl. 20.

Sp. *Ægа emarginata* Leach, Desmar., *Crust.* Pl. 47, figs. 4, 5;—*Ægа bicarinata* Leach, Rathke *Beitr. zur Fauna Norwegens*, Tab. VI. figs. 1—18, pp. 25—35.

*Cirolana* Leach.

*Eurydice* Leach, Edw. (*Eurydice* and species of *Nelocira* Leach).

*Serolis* Leach. Antennæ four, long, not covered at the base, with basal joints thicker, setaceous at the apex. Eyes two, large, reniform, situated in a tubercle, remote from the margin of head. Trunk broad, marked by a longitudinal furrow on each side. Abdomen with only three or four segments distinct, the last very large. Feet of the first pair (or in males, of first and second) thick, short, with strong incurved hook.

Sp. *Serolis Fabricii* LEACH, *Cymothoa paradoxa* FABR., BUCKLAND *Mineral. and Geology*, London, 1836. Pl. 45, figs. 6, 7 (after a drawing by CURTIS), CUV. *R. Ani. éd. ill., Crust.* Pl. 64, fig. 3, &c. This genus in the two longitudinal furrows on the back of the trunk bears a strong resemblance to the fossil Trilobites, but there is no proper affinity on this account.

Family XVI. *Sphæromida.* Body broad, oval, frequently contractile into a ball. Head large, broad. Feet not fixing themselves by hooks. Tail small, mostly composed of only two segments, the first five having coalesced to form one. The last pair of caudal feet with only a single moveable lamella extended near the outer side of pygidium. Foot-jaws resembling palps.

*Ancinus* EDW. First and second pairs of feet terminated by a large moveable hook, subcheliform; remaining feet gressorial, slender, terminated by a straight claw. Body depressed, plane. Antennæ long, setaceous.

Sp. *Ancinus depressus* MILNE EDWARDS, *Hist. nat. des Crust.* Pl. 32, fig. 17.

*Sphæroma* LATR. Feet of trunk all gressorial, slender, terminated by a short claw, often bifid. Body gibbous above, contractile into a ball (*Onisci globatores*).

Sp. *Sphæroma serratum* LEACH, *Oniscus globator* PALLAS, *Spicil. Zool.* IX. Tab. 4, fig. 18, DESMAR., *Crust.* Pl. 47, fig. 1; from 2‴ to more than 5‴ long, in the Atlantic ocean, the Mediterranean and the Black Sea.

*Note.*—Genus *Zuzara* LEACH is scarcely distinct.

Add sub-genera: *Cymodocea* LEACH, *Nœsea* LEACH (and *Cilicœa* ejusd.), *Campecopea* LEACH, *Cerceis* EDW., *Amphoroïdea* EDW., *Cassidina* EDW.

Family XVII. *Pranizidea.* First two segments of trunk indistinct or joined with the head, destitute of feet. Five pairs of feet of trunk. Antennæ four, setaceous, unequal. Posterior part of abdomen or tail with six segments, supplied with foliaceous appendages at the apex.

*Anceus* RISSO, *Gnathia* LEACH. Head large, almost square, armed anteriorly with two horns porrect, falcate (mandibles?).

Sp. *Anceus forficularius* RISSO, DESMAR., *Crust.* Pl. 46, fig. 7 (not fig. 6), GUÉRIN *Iconogr., Crust.* Pl. 27, fig. 7;—*Anceus maxillaris* LAM., *Cancer maxillaris* MONTAGU, *Linn. Trans.* VII. 1804, Tab. VI. fig. 2, DESMAR. *Crust.* Pl. 46, fig. 6.

*Praniza* LEACH. Head triangular, narrower than thorax. Mandibles not exsert. Trunk in females consisting of only three segments, the last three being confluent, and forming a single oval scutum broader than the preceding segments.

Sp. *Praniza cœrulata, Oniscus marinus* SLABBER, SLABBER *Natuurk. Verlust.* Tab. IX. figs. 1, 2 (copied in *Encycl. méth., Ins. et Crust.* Pl. 329, figs. 24, 25), MONTAGU *Trans. Linn.* XI. Tab. IV. fig. 2, &c.

Compare on this genus J. O. WESTWOOD, *Ann. des Sc. natur.* Tom. XXVII. 1832, pp. 316—332, Pl. 6.

Family XVIII. *Oniscides.* Two middle antennæ very short, of only one or two joints. Last segment of tail short, with the appendages of the last pair of caudal feet concealed or styliform.

Comp. J. F. BRANDT *Conspectus Monographiæ Crustaceorum Oniscodorum* LATREILLII, *Bulletin de la Société imp. des Natural. de Moscou,* VI. 1833, pp. 171—193, Tab. IV. figs. 6—21.

These *Isopods* may be named *Land-Asselli,* for although some of them keep to the sea-shore, they do not live in water. The most live under stones, bark of trees, in chinks of walls, &c. They gnaw various substances. At night especially they seek their food, which consists principally of vegetable matters.

A. *Oniscinea.* Basal joint of the last pair of abdominal feet short, not produced beyond the last segment of abdomen. Antennæ geniculate, with from six to nine joints (the five basal joints thicker, the terminal seta with one or two, three or four joints).

*Tylos* LATR. External antennæ moderate, with nine joints, the four terminal joints forming a short seta. Last pair of abdominal feet lamellose, concealed under abdomen. Body contractile into a ball.

Sp. *Tylos Latreillii* AUDOUIN, *Tylos armadillo* LATR., *Cloporte* SAVIGNY, *Descr. de l'Egypte, Crust.* Pl. 13, fig. 1, GUÉRIN *Iconogr., Crust.* Pl. 31, fig. 4, EDWARDS, CUV. *R. Anim. éd. illustr., Crust.* Pl. 70, fig. 2.

The first four pairs of abdominal feet have a broad quadrangular appendage, in which longitudinal cavities with blind branchings are found. They open at the inferior margin by a row of small foramina, and take up air for respiration. The animal lives on the coasts of Egypt and Algiers.

*Armadillo* LATR. External antennæ with seven joints. Styliform appendages of last pair of feet short, not prominent. Body contractile into a ball.

Sp. *Armadillo variegatus* LATR., *Armadillidium pustulatum* EDWARDS, VILLERS *Entom. Linn.* Tab. XI. fig. 16, DESMAREST *Crust.* Pl. 49, figs. 6, 7, &c.

To this division belong the *Millepedæ*, more used in medicine formerly than at present, *Armadillo officinarum*, BRANDT. u. RATZEBURG *Mediz. Zool.* II. Tab. 43, figs. 8—10, CUVIER *R. Ani. éd. ill., Crust.* Pl. 17, fig. 4; from the south of Europe and Syria.

Sub-genera: *Armadillidium* BRANDT, *Diploexochus* ejusd., *Cubaris* ejusd., *Armadillo* ejusd.

*Oniscus* nob. (species from genus *Oniscus* L., *Porcellio*, *Oniscus*, *Philoscia* LATR.). External antennæ with from six to nine joints. External appendage of last pair of abdominal feet styliform, exsert.

*Deto* GUÉRIN. External antennæ with nine joints, the four terminal joints small, forming a very short seta. Styliform appendages at last segment of body elongate.

Sp. *Deto echinata* GUÉRIN, *Magas. de Zool.* 1836. *Crust.* Pl. 14.

*Platyarthrus* BRANDT.

*Trichoniscus* BRANDT.

*Note.*—In these genera the external antennæ are six-jointed.

*Oniscus* LATR. External antennæ with eight joints, inserted under the anterior margin of head, which is somewhat prominent. Body not contractile into a ball.

Sp. *Oniscus asellus* L., *Oniscus murarius* CUV., DE GEER *Mém. p. s. à l'Hist. des Ins.* VII. Pl. 35, fig. 3, GEOFFR. *Ins.* II. Pl. XXII. fig. 1, BRANDT. u. RATZEBURG *Medizin. Zool.* II. Tab. XII. fig. 7; the *cellar-oniscus*, mostly 7‴ or 8‴ long, ash-grey above, with yellow spots on the side. This little animal is very common on walls in moist places.

*Porcellio* LATR. External antennæ with seven joints. Body in most not contractile into a ball.

Sp. *Porcellio scaber* LATR., BRANDT u. RATZEBURG *Mediz. Zool.* II. Tab. XII. fig. 6, GUÉRIN *Iconogr., Crust.* Pl. 31, fig. 7. In *Porcellio* and *Armadillo* (not in *Oniscus*) the external plates or covers of the two anterior abdominal feet have a whitish body, which is hollow internally, and receives air from a fissure by many openings. See DUVERNOY et LEREBOULLET *Ann. des Sc. nat.* 2e Série. Tom. XV. 1841. *Zool.* pp. 197, 198; comp. V. SIEBOLD in MUELLER'S *Archiv, Jahresbericht*, p. 141. LEREBOULLET found a similar structure in the external plate of the first five abdominal feet of two species of *Porcellio*, which roll themselves up, whence he named one of these *Porc. armadilloïdes*. Already DE GEER had noticed such a species that rolls itself up, *Oniscus convexus*, VII. p. 553, Pl. 35, fig. 11.

*Philoscia* LATR. External antennæ with eight joints, naked at the base. Segments of tail abruptly narrower behind the last segment of trunk.

Sp. *Oniscus muscorum* CUV.

B. *Ligiea.* Basal joint of last pair of abdominal feet slender, elongate, exsert, terminated by two long styles. External antennæ terminated by a seta composed of several (twelve to twenty) joints, long.

*Ligia* FABR.

Sp. *Ligia oceanica* FABR., BASTER *Natuurk. Uitspann.* II. Tab. XIII. fig. 4, DESMAR. *Crust.* Pl. 49, figs. 3, 4;—*Ligia italica* FABR., GUÉRIN *Iconogr., Crust.* Pl. 31, fig. 5, &c. These animals live on the sea-coast, but often leave the water and climb on stones, piles, &c. This genus forms the transition to the water-onisci.

Some species, in their antennæ resembling *Ligia*, have at the last abdominal feet a bifid basal piece, and at the extremity of these two pedicles is a filiform appendage. They live under stones or under moss, in moist meadows, in decaying wood, &c. They form the genus *Ligidium* BRANDT, *Zia* KOCH, in HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 180.

Sp. *Ligidium Personii* BRANDT, *Oniscus agilis* PERSOON, PANZER *Deutschl. Ins.* Heft 9, Tab. 24, &c.

Family XIX. *Asellota.* Antennæ four, distinct. Terminal appendages of last pair of abdominal feet produced beyond the body like a tail. Last segment of tail large, scutiform.

A. First pair of feet, either similar to the rest, or thickened at the apex, and with hook single.

† Four antennæ unequal, external much longer than internal.

* All the feet similar, terminated by short double claw.

*Oniscodà* LATR. (*Janira* LEACH).

*Jæridina* EDW.

Sp. *Janira Nordmanni* RATHKE, *Fauna der Krym*, p. 388, Tab. VI. figs. 1—5.

*Jæra* LEACH.

Sp. *Jæra nivalis* KROEYER, *Grönland's Amfipoder*, Tab. IV. fig. 21.

* * Anterior feet short, thickened at the apex, furnished with hook incurved.

*Munna* KROEYER. External antennæ very long. Feet, except the first pair, longer than body. Tail destitute of appendages.

Sp. *Munna Bœckii* KROEYER, *Tidsskrift*, II. 1839, pp. 612—616, with plate. (The specimen, described by KROEYER, seems not to have been full grown).

*Asellus* GEOFFR., SCHÆFFER, LATR. External antennæ elongate. Feet shorter than body. Two abdominal appendages terminated by two elongated filaments.

Sp. *Asellus vulgaris* LATR., *Oniscus aquaticus* L., GEOFFR. *Ins.* II. Pl. 22, fig. 2, DE GEER *Mém. p. s. à l'Hist. des Ins.* VII. Pl. 31, DESMAR. *Crust.* Pl. 49, figs. 1, 2, TREVIRANUS *Verm. Schr.* I. Tab. X. figs. 56, 57. This species is very common in wet ditches, and is almost $\frac{1}{2}$" long. The little animal passes the winter in the mud. It differs from the genus *Oniscus*, to which LINNÆUS united it, in the tail, which is covered above by only a single shield-like plate, and further, in the greater development of the middle antennæ and in the feet, which increase in length from the head to the tail.

*Limnoria* LEACH. Four antennæ short, subequal. Body cylindrico-linear.

Sp. *Limnoria terebrans* LEACH, *Trans. of the Linn. Soc.* XI. pp. 370, 371; a small animal (1—2‴) which perforates the piles and wood-work of marine jetties, and in a short time may destroy them.

B. First pair of feet short, thick, terminated by a didactylous chela.

*Apseudes* LEACH. Tail composed of six segments, terminated by two long filiform appendages of the last pair of feet.

Sp. *Apseudes talpa* LEACH, *Cancer gammarus talpa* MONTAGU, *Trans. of the Linn. Soc.* IX. p. 98, Pl. 4, fig. 6 (this figure is copied in the *Encycl. méthod., Crust. et Ins.* Pl. 336, fig. 26, DESMAR. *Crust.* Pl. 46, fig. 9). MILNE EDWARDS has given a better figure, CUV. *R. Anim. éd. ill., Crust.* Pl. 62, fig. 1.

*Tanais* EDWARDS.

Sp. *Tanais Cavolinii* MILNE EDWARDS, *Résumé d'Entom. par* MM. AUDOUIN *et* EDW. (*Encycl. portative*, 1829), I. p. 182, Pl. 29, fig. 1, EDW. *Hist. nat. des Crust.* Pl. 31, fig. 6.

Comp. on this genus KROEYER, *Naturh. Tidsskr.* IV. 1842, pp. 167—187. Tab. II. figs. 1—22.

*Zeuxo* TEMPLETON.

*Crossurus* RATHKE. (Not different perhaps from genus *Tanais*).

*Note.*—Add genus *Rhœa* EDW. (*Ann. des Sc. Nat.* XIII. 1828, pp. 292—296, Pl. 13 A), unless it be better to refer it to the *Amphipoda*. Genera *Eupheus* and *Olisca* RISSO, seem to be uncertain, and require confirmation by more diligent observation.

Perhaps also will have to be placed here amongst the *Isopoda*, *Oniscus arenarius* SLABBER *Natuurk. Verlust.* Tab. XI. fig. 4, genus *Pterygocera* LATR., CUV. *R. Ani.* 2nd éd. 1829, IV. p. 124.

Family XX. *Idoteidea*. Tail mostly composed of only three distinct segments, with last segment large, scutiform. Abdominal feet branchial; last pair of feet forming opercular laminæ covering the branchiæ beneath. No appendages exsert in the last segment or at the sides of tail. Antennæ four, very frequently unequal, the middle approximate. Mandibles destitute of palps.

*Anthura* LEACH. Four antennæ, short, subulate. Body slender, vermiform. Anterior feet incrassated, terminated by an incurved hook. Tail with two distinct segments.

Sp. *Anthura gracilis* LEACH, *Oniscus gracilis* MONTAGU, DESMAR. *Crust.* Pl. 46, fig. 13, MILNE EDWARDS *Hist. nat. des Crust.* Pl. 31, figs. 3—5.

*Idotea* FABR. Middle antennæ short, with four joints, the last elongate, cylindrical; external antennæ large, with first five joints thicker, the rest more slender, running into a terminal seta. All the feet of trunk terminated by an incurved claw; those of the first, second and third pairs raptorial, incrassated at the apex and turned forwards. Branchial feet of tail covered by the last pair of feet changed into two valves articulated by means of a hinge to the last segment.

Sp. *Idotea entomon* FABR., *Oniscus entomon* L. (in part), PALLAS *Spicil. Zool.* IX. Tab. V. figs. 1—6, DE GEER *Mém. p. s. à l'Hist. des Ins.* VI. Pl. 32, figs. 1—10, RATHKE *Beitr. zur Gesch. der Thierwelt*, I. Danzig, 1820, Tab. IV. This animal was found in the Baltic Sea; it attains a length of 1″ 9‴. Its two small black eyes are situated at the side of the head in a round pit, and are not, as is erroneously supposed, simple, but each of them consists of a group of more than 50 small oval eyes placed close together.—*Idotea Lichtensteinii* KRAUSS, *Südafrik. Crustaceen*, Stuttgart, 1843, Tab. IV. fig. 4.

*Idotea linearis* LATR., *Stenosoma lineare* LEACH, BASTER *Natuurk. Uitsp.* II. Tab. XIII. fig. 2, DESMAR. *Crust.* Pl. 46, fig. 12; from the Baltic, about 1″ long.

To this division also belongs *Oniscus viridis* of SLABBER, *Natuurk. Verlust.* Pl. 12, figs. 4, 5, which, according to MILNE EDWARDS, forms a distinct genus.

*Arcturus* LATR. Feet of first pair short, palpiform. Feet of second, third and fourth pair furnished with long hairs, with last joint plane, elongate. External antennæ of the length of body.

Sp. *Arcturus Baffini* WESTW., *Idotea Baffini* SABINE, MILNE EDWARDS *Hist. nat. des Crust.* Pl. 31, fig. 1;—*Arcturus longicornis* WESTW., GUÉRIN *Iconogr., Crust.* Pl. 31, fig. 2; in this species the first four pairs of feet stand very remote from the last three.

## ORDER VIII. *Amphipoda.*

Eyes sessile. Four antennæ, the two middle inserted above the lateral. Mandibles mostly furnished with palps. Two pairs of maxillæ and one pair of foot-jaws. Trunk mostly divided into seven distinct segments, bearing seven pairs of feet not cloven into two oars. Membranous vesicles for respiration adhering to the base of some of the feet.

We unite here, after the idea of KROEYER, the *Læmodipoda* of LATREILLE with the order of the *Amphipods;* see KROEYER *Tidsskrift*, IV. 1843, pp. 490—495.

Section I. *Læmodipoda.* Posterior part of abdomen or tail short. First segment of trunk conjoined with head, an oblique furrow alone on each side indicating the separation; feet of this segment inserted forwards, beneath the head. Two or three pairs of branchial vesicles in the anterior part of trunk.

*Læmodipoda* from λαιμὸς and δίπους; these animals were thus named because they have two feet under the head, as though at the throat. They do not swim, but creep on marine plants and animals in search of food. The posterior part of the body is little developed. In most the feet are wanting in those rings that carry gill-vesicles, and conversely the gill-vesicles are wanting on those rings that have feet.

Family XXI. *Læmodipoda.* (Characters of the section).

Phalanx I. *Cyamea.* Body oval, mostly much depressed, with transverse segments. Antennæ with four joints, the last slender;

inferior antennæ small. Two pairs of cylindrical branchiæ at the second and third segment of the trunk, in place of feet. Feet strong, terminated by an incurved hook, in five pairs. Mandibular palps none. Females furnished with large laminæ at the base of branchiæ, covering the eggs.

*Cyamus* LATR. (Species of *Oniscus* L.).

Sp. *Cyamus ceti* LATR., *Oniscus ceti* L., *Pycnogonum ceti* FABR., PALL. *Spic. Zool.* Fasc. IX. Tab. 14, DE GEER *Mém. p. serv. à l'Hist. des Ins.* VII. pp. 540—544, Pl. 42, figs. 7, 8, TREVIRANUS *Verm. Schr.* II. pp. 3—10, Tab. I. This Crustacean, whose length is about ½" and more, lives on *Balæna longimanâ; Cyamus erraticus* ROUSSEL DE VAUZ., on the whale of the southern hemisphere, is an allied species. *Cyamus gracilis* ROUSS. DE VAUZ. is smaller and more elongate than the other species, and thus approaches to the form of the next division.

Comp. on this genus, besides the anatomical notices of G. R. TREVIRANUS, ROUSSEL DE VAUZÈME, *Ann. des Sc. nat.*, 2e Série, Tom. I. 1834, *Zool.* pp. 239—265, Pl. 8, 9, and KROEYER *Natuurk. Tidsskr.* IV. pp. 474—489.

Phalanx II. *Caprellina.* Body mostly elongate, the length of the segments surpassing their breath. Feet slender. Branchiæ vesicular at the base of feet. Mandibles often furnished with palp triarticulate. Superior antennæ setaceous at the apex, multiarticulate.

*Caprella* LAM. Five pairs of feet, arranged in an interrupted series, all terminated by a subcheliform hand. Two pairs of branchial vesicles in the second and third segments, in place of feet. Abdomen very minute, made up of a single or of two segments, supplied with appendages or rudiments of feet.

Sub-genera: *Caprella* and *Ægina* KROEYER. Sp. *Caprella linearis* LATR., *Cancer linearis* (L. ?), HERBST *Krabben und Krebse*, IV. p. 142, Tab. 36, figs. 9, 10;—*Oniscus scolopendroïdes* PALL., *Spic. Zool.* IX. Tab. 4, fig. 15, *Caprella lobata* LATR., GUÉRIN *Iconogr., Crust.* Pl. 28, fig. 2; to this or to *Capr. acutifrons* DESM. the figure of BASTER, *Natuurk. Uitsp.* I. Pl. IV. fig. 2, seems also to belong.

*Podalirius* KROEYER.

*Cercops* KROEYER. Three pairs of branchial vesicles, the first pair at the base of the second pair of feet, the rest in place of feet. Abdomen distinct quinquearticulate.

Sp. *Cercops Holbœlli* KROEYER l. l. Tab. VI. figs. 1—13.

*Leptomera* LATR. (*Proto* LEACH). Seven pairs of feet, arranged in a continuous series. Fifth pair of feet shorter, furnished with a small claw, slightly moveable. Three pairs of branchial vesicles at the bases of the second, third and fourth pairs of feet. Abdomen small, uniarticulate, with four appendages, elongate, biarticulate.

Sp. *Leptomera pedata, Gammarus pedatus* ABILDGAARD, MUELLER *Zool. danic.* Tab. 101, figs. 1, 2, GUÉRIN *Iconogr., Crust.* Pl. 28, fig. 3. According to KROEYER *Leptomera ventricosa* DESMAREST, *Squilla ventricosa* MUELL. *Zool. dan.* is the female of this species. To it belongs also *Phthisica marina* SLABBER *Natuurk. Verlust.* Pl. X. figs. 1, 2.

The genus *Proto* of DESMAREST (*Crust.* p. 276) rests on imperfect observations, and appears not to differ from *Naupredia* LATR.

Section II. Genuine *Amphipoda*. Head distinct from the first segment sustaining a pair of feet. Segments of trunk mostly furnished with a distinct lateral part (*epimeron*). Mandibles supplied with palp. Tail made up of several segments, furnished with bifid feet. Body mostly compressed, arcuate.

Comp. MILNE EDWARDS *Ann. des Sc. nat.* XX. 1830, pp. 353—399, and H. KROEYER *Grœnland's Amfipoder*. Kjöbenhavn, 1838. 4to. (printed separately from VII. *Th. der Kongel. Danske Videnskabernes Selskabs naturvid. og mathem. Afhandlinger*, p. 229, &c.)

Family XXII. *Hyperina* or *Uroptera*. Foot-jaws small, not covering the cibarious organs. Head large. Last abdominal feet at the apex of tail mostly resembling a flabelliform fin, foliaceous.

*Oxycephalus* EDW.

*Pronoë* GUÉRIN.

*Typhis* RISSO, EDW.

Sp. *Typhis ferus* EDW. *Ann. des Sc. nat.* l. l. Pl. 11, fig. 8, GUÉRIN *Iconogr., Crust.* Pl. 27, fig. 8; in the Atlantic near the Canary Islands. This genus and the preceding are remarkable for their long inferior antennæ, which are bent at three acute angles.

*Phronima* LATR. Antennæ two short. Fifth pair of feet elongate, terminated by a hand broad, didactylous. Tail elongate, with five distinct segments, the sixth segment coalesced with fifth.

Sp. *Phronima sedentaria* LATR., *Cancer sedentarius* FORSK., HERBST *Krabben und Krebse*, II. p. 136, Tab. 36, fig. 8, LATR. *Gener. Crust. et Ins.* Tab. II. figs. 2, 3; this animal is found in the Mediterranean, where it lives in a kind of gelatinous keg, open at both ends, probably from a dead *Beroë*.

*Primno* GUÉRIN.

*Themisto* GUÉRIN.

See GUÉRIN *Mém. de la Soc. d'Hist. nat. de Paris*, IV. pp. 379–386, Pl. 23; KROEYER *Grœnl. Amfip.* pp. 63—68, Tab. IV. figs. 16, 17.

*Phrosina* RISSO, *Dactylocera* LATR.

*Anchylomera* EDW.

*Hieraconyx* GUÉRIN.

*Hyperia* LATR. Antennæ four. Feet slender, terminated by an incurved hook. Trunk broad, gibbous above; tail attenuated.

*Lestrigonus* EDW., *Tyro* EDW., *Phorcus* EDW., *Hyperia* EDW., *Metoëcus* KROEYER.

Sp. *Hyperia Latreillii* EDW., *Ann. des Sc. nat.* XX. Pl. 11, figs. 1—7, GUÉRIN *Iconogr., Crust.* Pl. 25, fig. 5; *Hiella Orbignii* STRAUS-DURCKHEIM, *Mém. du Mus.* XVIII. 1829, Pl. 4.

*Note.*—Genus *Daira* EDW., is distinguished by having only two short antennæ, and by the second pair of feet being didactylous. *Metoëcus* KROEYER, furnished with four short subulate antennæ, differs from the other *Hyperiæ* by the first and second pairs of feet being shorter and terminated by a didactylous chela. *Grœnl. Amfip.* pp. 60—63, Tab. IV. fig. 15.

Family XXIII. *Gammarina.* Foot-jaws large, conjoined at the base, forming an accessory inferior labium, covering the cibarious organs; cloven anteriorly into two laminæ, and on the outside sustaining an articulate palp. Last caudal feet terminated by appendages styliform, more rarely foliaceous, not resembling a fin. Head congruous.

Comp. H. KROEYER *Nye nordiske Slægter og Arter, henhörende til Familien Gammarina. Tidsskrift.* IV. 1842, pp. 141—166.

A. Lateral parts of segments of trunk (*epimera*) moderate, not covering the bases of feet. Abdominal feet six; the last terminated by two small oval laminæ.

*Vibilia* EDW.

*Corophium* LATR. Two inferior antennæ large, thick, pediform.

Sp. *Corophium longicorne, Cancer grossipes* L., *Oniscus volutator* PALL., *Miscell. Zool.* Tab. IV. fig. 20, *Spic. Zool.* IX. Tab. 4, fig. 9, GRONOV. *Zoophylac.* Tab. XVII. fig. 7, GUÉRIN *Iconogr., Crust.* Pl. 27, fig. 1.

Add genera: *Cerapus* SAY, *Atylus* LEACH, *Podocerus* LEACH, &c. Comp. MILNE EDWARDS, *Hist. Nat. des Crust.* III. pp. 58—70. Genus *Erichthonius* MILNE EDWARDS, on the authority of KROEYER, does not differ from *Podocerus*, but rests on a sexual difference of the males. *Tidsskr.* IV. 1842, pp. 163, 164.

B. Four first segments of trunk with epimera large, covering the bases of feet. Abdominal feet six; the last terminated by styles, serving with the apex of the incurved tail for jumping.

Body depressed. Anterior either all or the inferior terminated by a filament setaceous, multiarticulate.

*Talitrus* LATR. Mandibles furnished with a rudiment only of palp or destitute of palp. Superior antennæ not longer than head, shorter than the pedicle of inferior; inferior elongate.

Genera: *Talitrus* and *Orchestia* LEACH.

Sp. *Talitrus saltator* EDW., *Cancer locusta* L., PALL. *Spic. Zool.* IX. Tab. 4, fig. 7, DESMAR. *Crust.* Pl. 45, fig. 2, CUV. *R. Ani. éd. ill., Crust.* Pl. 59, fig. 3. This little animal, about ½" in size, is very common on the Dutch coast, where it is constantly progressing in the sand by jumping.

*Orchestia* is distinguished by the sheer-shaped form of the first and second pairs of feet; the second pair has a large oval joint at the apex, on which the moveable curved claw is set; here belongs *Orchestia littorea* LEACH, BASTER *Natuurk. Uitsp.* II. Tab. 3, figs. 7, 8, DESMAR. *Crust.* Pl. 45, fig. 3.

*Gammarus* LATR. (Species from genus *Gammarus* FABR.). Mandibles furnished with palp. Superior antennæ always longer than the peduncle of inferior, sometimes longer than inferior themselves.

Sub-genera: *Lysianassa* EDW. (*Anonyx* KROEYER), *Alibrotus* EDW. (*Lysianassa* previously), *Phlias* GUÉRIN, *Acanthonotus* OWEN, *Isæa* EDW., *Anisopus* TEMPLET., *Amphitoë* LEACH, *Gammarus* EDW., *Ischyrocerus* KROEYER, *Leucothoë* LEACH (*Lycesta* SAV.) and some others proposed by KROEYER l. l.

Sp. *Gammarus fluviatilis* EDW., *Gammarus pulex* KOCH, RŒSEL *Ins.* III. *Suppl.* Tab. 62; KOCH and GERVAIS distinguish this species as *Gammarus Rœselii* from *Gammarus pulex* FABR., DESMAR. *Crust.* Pl. 45, fig. 8, *Gammarus fossarum* KOCH in HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 138, Tab. 1. LINNÆUS has confounded not only these two species, but also

others, as *Orchestia littorea*, under the name of *Cancer pulex*, *Syst. nat.* ed. 12, I. p. 1055[1].

*Gammarus pulex* FABR., GERV. is very common in ponds. The female carries her eggs under the body at the base of the feet, until the young emerge. RŒSEL saw the animals nibbling at roots, fruits, and other parts of plants which he gave them. Usually, however, they live on animal food, and according to DE GEER, do not spare even the bodies of their companions. They attain a length of about ½". The hinder end of the body is always bent downwards. Compare also on this species J. C. ZENKER *De Gammari pulicis* FABR. *Hist. naturali et sanguinis circuitu commentatio. Accedit Tab. æn.* Jenæ, 1832, 4to, and, on the difference of the two species, GERVAIS *Ann. des Sc. nat.* 2e Série, IV. 1835, *Zoologie*, pp. 127, 128.

## ORDER IX. *Stomatopoda.*

Two compound eyes, placed on a biarticulate moveable petiole. Antennæ four, placed nearly in the same horizontal row; internal long, terminated by two or three multiarticulate setæ, external mostly furnished at the base with an oval ciliated lamina. Feet of trunk mostly in seven or six pairs, more rarely eight. Mouth inferior, often situated between the bases of anterior feet. Branchiæ mostly adhering to the caudal feet, more rarely to the thoracic, never covered. Tail mostly terminated posteriorly by a foliaceous pinna. Shell thin, in many almost membranous.

Family XXIV. *Unipeltata.* Body elongate, narrow. Cephalothoracic shield elongate, often produced over the back of the anterior segments of trunk. Anterior segment of cephalothoracic shield, bearing the middle antennæ and eyes, distinct. One pair of maxilliform feet slender, elongate. Seven pairs of feet in trunk or thorax; first pair large, with last joint mostly falcate, dentate internally; second, third and fourth pairs shorter, approximate to mouth, terminated by an oval hand and moveable hook; three last pairs slender, remote, mostly furnished with a styliform appendage. Of caudal feet six pairs; the first five mostly bearing branchiæ of

[1] From a passage in the *Fauna Suecica* p. 246 "*habitat ad littora maris vulgatissimus*" it would seem, that LINNÆUS probably by *Cancer pulex* had a species in view different from *Gammarus pulex* or *fluviatilis*, perhaps *Gammarus locusta* FABR.; that he also confounded *Orchestia* with it appears, however, from his citation of BASTER. Hence it is impossible to quote with justice *Cancer pulex* L. as a synonym of a determinate species.

many filaments set pectinately on a peduncular cirrus; last pair terminated by two laminæ oval, depressed, forming the pinna of tail.

*Squilla* FABR. (in part). Cephalothoracic shield tripartite from two longitudinal furrows, not covering the last segment of trunk at least, mostly not covering the three last segments. Branchiæ distinct adhering to the first five pairs of abdominal feet.

Comp. LATREILLE *Encycl. méth., Hist. nat., Ins.* Tom. x. pp. 467–475.

*Coronis* LATR. Six last feet of trunk with appendage oval, plane, membranous.

Sp. *Coronis scolopendra* LATR., GUÉRIN *Iconogr., Crust.* Pl. 24, fig. 2, &c.

*Squilla* LATR. (and *Gonodactylus* ejusd.). Six last feet of trunk with appendage elongate, styliform.

Sp. *Squilla scyllarus* FABR., RUMPHIUS *Amb. Raritcitkam.* Tab. III. fig. F;—*Squilla chiragra* HERBST, *Krabben*, Tab. 34, fig. 2, LATREILLE *Encycl. méth., Crust. et Ins.* Pl. 325, fig. 2. These species, in which the terminal joint of the shears is almost or entirely toothless and swollen at the base, form the genus *Gonodactylus* LATR. In most species this joint is small, curved and densely toothed within. As, for example, *Squilla mantis* FABR. (*Cancer mantis* L. in part), DESMAR. *Crust.* Pl. 41, fig. 2, from the Mediterranean, *Squilla maculata* RUMPH. Tab. cit. fig. E, from the Moluccas, &c.

*Squillerichthus* EDW.

*Erichthus* LATR., *Smerdis* LEACH. Shell of cephalothorax not sulcate, produced over the last three segments of trunk. Rudiments alone of branchiæ, adhering to the first pair of caudal feet, or branchiæ none distinct.

Sp. *Erichthus vitreus* LATR., *Squilla vitrea* FABR., *Smerdis vulgaris* LEACH, DESM. *Crust.* Pl. 44, fig. 2, &c.

*Alima* LEACH.

Comp. on this and the preceding genus, LEACH in TUCKEY'S *Narrative of an Expedition to explore the river Zaire.* London, 1818, 4to, pp. 415, 416, and fig. Pl. XI.

Family XXV. *Bipeltata.* Cephalothoracic shield membranous, pellucid, produced over the segments of trunk. Middle antennæ terminated by two filaments. Six pairs of feet slender, elongate, furnished with a cirrus multiarticulate, pilose.

*Phyllosoma* LEACH. Body depressed, covered by two shields, the first oval, the second transverse, placed above the trunk. Eyes set upon a long petiole.

Comp. LEACH in TUCKEY'S *Expedit. to the Zaire*, pp. 416, 417, and fig. Pl. XI., *Journal de Physique*, Tom. 86, 1818, pp. 306, 307, GUÉRIN *Mém. sur l'Organisation des Phyllosomes et Monographie de ce genre de Crust. Magasin de Zool.* 1833, Cl. VII. Pl. 6—13, C. GEGENBAUR *Ueber Phyllosoma* in SIEBOLD and KOELLIKER *Zeitsch. f. wissensch. Zool.* V. 1853, p. 352. The latter author, from the consideration of the circulation, which in its more minute details agrees with that of the decapods, thinks that *Phyllosoma* ought to be arranged with these.

a) *External antennæ setaceous, longer than internal.* Abdomen distinct from trunk, divided into segments, with terminal pinna.

Sp. *Phyllosoma commune* TUCKEY l. l., with fig., DESMAR. *Crust.* Pl. 44, fig. 5.—*Phyllosoma clavicorne* TUCKEY ibid. with fig., DESMAR. ibid. fig. 4.

b) *External antennæ lamellose, increased by a lobe at the base, shorter than internal.* Abdomen very short or triangular, continuous with the shield of trunk.

Sp. *Phyllosoma laticorne* TUCKEY l. l., *Cancer cassideus* J. FORSTER, *Naturforscher* XVII. pp. 206—213, Tab. 5.

Most of the species come from the Indian and African seas; yet one species from the Mediterranean is known. These animals gave occasion to the name of the family which does not apply to the following genus.

*Amphion* EDW. Shell elongate, oblong, continuous, covering head and all the segments of trunk. Tail narrow, conical, composed of seven segments, terminated by a flabelliform pinna. External antennæ long, furnished with an oval scale at the base, filiform.

Sp. *Amphion Reynaudii* MILNE EDWARDS, *Ann. de la Soc. entomol.* I. 1832, pp. 336—340, Pl. 12 A, *Hist. nat. des Crust.* Pl. 28, fig. 8.

Family XXVI. *Caridioïdea* or *Schizopoda.* Shell covering head and trunk, descending to the sides over the bases of feet, compressed. Abdomen long, made up of seven segments, the seventh with two lamellæ of the last abdominal feet on each side composing a flabelliform pinna. Feet of trunk slender, natatory.

This family forms by its *habitus* the transition to the following, from which, however, it differs by the absence of shear-shaped feet and by the gills not being included within the shell.

*Leucifer* THOMPSON, EDW. Head narrow, produced into a peduncle sustaining the antennæ and petiolate eyes, longer than the thoracic shield. Abdomen slender, elongate, with segments oblong. (Branchiæ unknown.)

Compare EDWARDS *Hist. nat. des Crust.* II. pp. 467—469, Plate 26, fig. 10. Habit, excepting the head, nearly that of *Alima*.

*Thysanopus* (*Thysanopoda* EDW.). Shell anteriorly acuminate, or supplied with a rostrum. Maxilliform feet none. Eight pairs of feet of trunk; first seven slender, supplied with a cirrus or long external oar. Branchiæ ramose, fasciculate, adhering to the base of thoracic feet, free. First five pairs of abdominal feet bifid, natatory.

Sp. *Thysanopus tricuspidatus* MILNE EDWARDS, *Ann. des Sc. nat.* Tom. XIX. 1830, pp. 451—460, Pl. 19, *Hist. nat. des Crust.* Pl. 26, fig. 1.

*Cynthia* THOMPSON.

*Mysis* LATR. Shell with rostrum none or very short anteriorly, deeply emarginate posteriorly. Antennæ long, external, with a basal lamellose appendage. Two pairs of maxilliform feet. Six pairs of feet of trunk natatory, furnished with a long external articulate cirrus. Branchiæ none distinct.

Sp. *Mysis flexuosa, Cancer flexuosus* MUELL., *Zool. danic.* Tab. 66, figs. 1—9, HERBST *Krabben*, Tab. 34, figs. 8, 9, RATHKE *Beitr. zur Fauna Norwegens*, pp. 18—20.—*Mysis oculata, Cancer oculatus* O. F. FABRICII *Fauna Grœnl.* pp. 245, fig. 1 (copied in HERBST Tab. 34, figs. 5, 6), &c. The size of the species of this genus varies from 6'''—1''; their synonymy is still very uncertain and confused.

The thin dorsal shield or the shell probably serves for respiration, as in *Apus*. Compare on the structure of this genus H. FREY u. LEUCKART, *Beiträge zur Kenntniss wirbelloser Thiere*. Braunschweig, 1847, 4to, s. 110—130.

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Family of uncertain position. *Cumacea* KROEYER.

*Cuma* EDW.

Compare EDWARDS *Ann. des Sc. nat.* XIII. 1828, pp. 294—296. EDWARDS, at a later period (*Hist. nat. des Crust.* III. p. 553) announced the opinion that this genus has no foundation, and that the little animal

observed by him might really be the larva of some decapod. KROEYER (*Tidsskr.* III. 1841, pp. 503—534) has refuted this, having found other species of this form, and females with eggs in a sac beneath the abdomen. *Cuma* is thus an adult animal. It has no eyes, almost the form of a long-tailed decapod, but five thoracic rings are not covered by the shell. The superior antennæ are short, the inferior in the female very short and rudimentary, in the male long. The feet have no shears. These animals resemble the *Caridina*, but perhaps better still might they be referred to the stomapods. GOODSIR and KROEYER have adopted some new genera in this small family: *Leucon* KROEYER, *Bodotria* GOODSIR and *Alauna* GOODSIR, which last genus, however, KROEYER characterizes differently. See hereon *Tidsskrift, Ny Raekke*, II. 1846, pp. 123—211.

## ORDER X. *Decapoda.*

Two compound eyes, placed on a petiole moveable, biarticulate. Antennæ four. Carapace large, covering head, thorax and anterior abdomen. Branchiæ adhering to the base of the posterior maxilliform feet and of the feet of trunk, pyramidal, covered by the sides of the shield. Mostly three pairs of maxilliform feet, in a few only two pairs. Feet of trunk not changed, almost always in five pairs, in some six. Mandibles almost always furnished with a palp.

Most crustaceans of this order have a very hard covering, and to it, with the exception of the *Limuli*, the largest species belong: but there are many small ones also. It is the most numerous and the most important to man on account of the quantity of edible species.

Section I. *Macroura.* Post-abdomen large, often longer than cephalothorax. Penultimate segment with lateral appendages forming with the last segment a terminal pinna of the tail, mostly flabelliform.

Antennæ long, the middle exsert, terminated by two or three setaceous filaments. Vulvæ situated in the first joint of the third pair of feet.

The third pair of foot-jaws are elongate, whilst on the contrary they are broad in the following division and cover the oral apparatus. The caudal feet are mostly more developed than in the following division, and serve for swimming. The shell is not so thick as in the *Brachyura* and at the same time less hard.

Family XXVII. *Caridina.* Middle antennæ inserted mostly above the lateral, more rarely in the same horizontal plane as lateral.

Peduncle of lateral antennæ entirely covered by a large scale. Body compressed, with post-abdomen incurved. Integuments thin, almost membranous.

*Acetes* EDW. Maxilliform feet in two pairs. Only four pairs of feet of trunk, the last two pairs being deficient; all filiform, long, none didactylous.

Sp. *Acetes indicus* EDWARDS, *Ann. des Sc. nat.* XIX. 1830, p. 350, Pl. XI. fig. 1.

*Sergestes* EDW. Maxilliform feet in two pairs. Feet of trunk in six pairs, filiform, slender, last pair very small, none didactylous.

Sp. *Serg. atlanticus* MILNE EDWARDS, *Ann. des Sc. nat.* XIX. Pl. X. fig. 1.

*Penæus* FABR. Feet slender, furnished with a palpiform lamellose appendage at the base; three anterior pairs armed with a small didactylous chela. Lateral antennæ very long. Shell carinate.

Sp. *Penæus sulcatus, Palæmon sulcatus* OLIV., EDW. *Hist. nat. des Crust.* Pl. 25, fig. 1;—*Penæus trisulcatus* LEACH, DESMAR. *Crust.* Pl. 39, fig. 3;—*Penæus setiferus, Cancer setiferus* L., SEBA *Thesaur.* III. Tab. 17, fig. 2 (copied in *Encycl. méth., Crust.* Pl. 291, fig. 2) &c.

Add genera: *Sicyonia* EDW., *Euphema* EDW., *Stenopus* LATR., *Aristeus* DUVERNOY.

*Ephyra* ROUX.

*Pasiphæa* SAVIGNY. (In these and the following genus only two anterior pairs of feet are didactylous.)

*Oplophorus* EDW.

*Palæmon* DALD., FABR. Middle antennæ superior, with three setæ. Shell carinate in the middle, keel produced anteriorly into a recurved serrated rostrum. Feet of trunk in five pairs, without palp or lateral appendage; two anterior pairs didactylous.

Sp. *Palæmon squilla* FABR., *Cancer squilla* L., BASTER *Natuurk. Uitspann.* II. Tab. III. fig. 5, GUÉRIN *Iconogr., Crust.* Pl. 22, fig. 1; the *prawn* (*steurkrab, crevette, salicocque*) &c. A fossil species, from the lithographic stone, *Palæmon spinipes,* of which BAJER (*Oryctogr. Norica.* 1758, Tab. VIII. *Suppl.* fig. 9) and WALCH and KNORR have given figures, the last of which is copied by DESMAREST *Crust. fossiles,* Tab. XI. fig. 4, appears to stand between *Palæmon* and *Sergestes* and has long spines on the fore feet.

Add genera: *Pandalus* LEACH, *Lysmata* RISSO.

*Hippolyte* LEACH. Middle antennæ superior, with two setæ, the external seta excavated beneath, external antennæ with a lamellose appendage elongate, obtuse, and a long multiarticulate seta. Shell carinate, supplied anteriorly with a serrated frontal rostrum. Third pair of maxilliform feet narrow, mostly furnished with a pilose palp at the base. Five pairs of feet, the two anterior didactylous. Abdomen gibbous, with third segment large, fourth inflected beneath, and incurved.

Sp. *Hippolyte Sowerbyi* LEACH, DESMAR. *Crust.* Pl. 39, fig. 1, &c. Compare on this genus H. KROEYER in *Kongel. Danske Vidensk. Selsk. naturv. og math. Afh.* IX. 1842, pp. 209—360.

*Rhynchocinetes* EDW.

*Gnathophyllum* LATR.

*Alpheus* FABR.

*Pontonia* LATR.

Sp. *Pontonia tyrrhena* LATR., *Alpheus pinnophylax* OTTO, *Nov. Act. Acad. Cæs. Leop. Carol.* XII. 1828, Tab. XXI. figs. 1, 2.

Add genera: *Athanas* LEACH, *Nika* RISSO, *Atya* LEACH and some others, on which see MILNE EDWARDS, *Hist. nat. des Crust.* II. pp. 347—366.

*Crangon* FABR. Four antennæ inserted almost in the same plane, dilated at the base, terminated by a double filament. Shell depressed, with a very short anterior process. Five pairs of feet, first pair thicker than the rest, subdidactylous, with internal finger very short, immoveable.

Sp. *Crangon vulgaris* FABR., *Cancer crangon* L., ROESEL *Ins.* III. Tab. 63, BASTER *Natuurk. Uitsp.* II. Tab. III. figs. 1—4, TH. BELL *Brit. Crust.*[1] p. 256. The *Shrimp, crevette*; attains a length of fully 2"; the second pair of feet is about as long as the third; this species is very common on our shores, and well known on account of the agreeable taste of its flesh. In some other species the second pair of feet is very short. They form the genus *Egeon* RISSO, *Pontophilus* LEACH.

Add genera: *Sabinea* OWEN, *Argis* KROEYER.

Compare KROEYER *Tidsskr.* IV. 1842, pp. 267, 268.

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[1] *A History of British Crustacea*, by TH. BELL. London, 1844 to 1848, 8vo. (only VI. parts have yet appeared; this work contains very beautiful wood-cuts).

Family XXVIII. *Astacina.* Four antennæ inserted in nearly the same transverse line, unequal, the middle with two setæ, shorter. Anterior feet chelate. Shell mostly hard, calcareous. Branchiæ fasciculate, composed of cylindrical filaments.

*Astacus* GRONOV., FABR. Lamellar appendage, dentiform or hastate, mostly small, at the base of lateral antennæ. Three first pairs of feet didactylous, first pair large, thick. Caudal pinna with lateral lamellæ bipartite transversely.

*Nephrops* LEACH. Scale at the base of external antennæ longer than the peduncle. Eyes large, reniform. Frontal rostrum elongate, denticulate on both sides.

Sp. *Nephrops norwegicus* LEACH, *Cancer norwegicus* L., DESM. *Crust.* Pl. 37, fig. 1, GUÉRIN *Iconogr., Crust.* Pl. 19, fig. 1.

*Astacus* LEACH (*Astacus* and *Homarus* EDW.).

*a)* Last segment of thorax mobile. Squama of external antennæ mobile, acuminate. *Astacus.*

*Astacus fluviatilis* FABR., *Cancer astacus* L., RÖSEL *Ins.* III. *Suppl.* Tab. 54—61, GUÉRIN *Iconogr., Crust.* Pl. 19, fig. 2, HERRICH-SCHÆFFER *Deutschl. Ins.* Heft 186, Tab. 23; the *cray-fish, river-cray;* attains a length of 3″ to 4″. Of this species, which is dispersed almost over the whole of Europe, there are some varieties which KOCH considers to be species. HERRICH-SCHÆFFER l. l. Heft 140, 186.

*b)* Last segment of thorax cohering with penultimate by an immoveable connexion. Scale of external antennæ small, dentiform. *Gammarus* or *Homarus.*

Sp. *Astacus marinus, Cancer gammarus* L., BASTER *Natuurk. Uitsp.* II. Tab. 1. DESMAR. *Crust.* Pl. 41, fig. 1, the *lobster, sea-cray;* on the coast of Norway especially.

Compare on the different species of this genus ERICHSON *Archiv,* 1846, pp. 86—103, 375—377.

*Eryon* DESMAR. (Fossil genus; see DESMAR. *Hist. nat. des Crust. fossiles,* p. 128.)

Sp. *Eryon Cuvierii* DESM., BAJERI *Oryctogr. nor.* Tab. 8, *Suppl.* fig. 1, DESMAREST *Crust. foss.* Pl. 19, fig. 3, in the lithographic stone; compare BRONN *Leth. geogn.* pp. 473, 474.

*Thalassina* LATR. Scale at the base of external antennæ mostly none, in a few very small. Four anterior feet, sometimes only two, didactylous. Lateral lamellæ of caudal pinna undivided. Posterior part of abdomen or tail elongate.

Compare LEACH *On the characters of the genus* Thalassina *of* LATREILLE, *Zool. Misc.* III. 1817, pp. 27, 28.

† *Accessory branchial appendages cylindrical, dichotomous, adhering to the abdominal feet.*

*Callinidea* EDW.

*Callinisea* EDW., *Isea* GUÉRIN.

Compare GUÉRIN *Description d'un nouveau genre de crustace macroure. Ann. de la Soc. entom. de France*, I. 1832, pp. 295—300.

† † *External branchiæ none.*

a) *Four anterior feet didactylous.*

*Thalassina* LATR. (in part), LEACH, *Axius* LEACH, *Callianassa* LEACH.

Sp. *Thalassina scorpionides, Cancer anomalus* HERBST, LEACH *Zool. Misc.* Tab. 130, DESMAR. *Crust.* Pl. 35, fig. 1, GUÉRIN *Iconogr., Crust.* Pl. 18, fig. 4; from the coast of Chili;—*Callianassa subterranea* LEACH, DESMAR. *Crust.* Pl. 36, fig. 2, GUÉRIN *Iconogr., Crust.* Pl. 19, fig. 4, on some parts of the English coast and in the Mediterranean. According to EDWARDS *Callian. laticauda* OTTO, *Nov. Act. Acad. Cæs. Leop. Car.* Tom. XIV. Tab. 21, fig. 3, is not specifically different from it.

b) *Two anterior feet alone didactylous.*

Genera: *Gebia* LEACH and *Glaucothoë* EDW. (*Prophylax* LATR.?)

*Note.*—Genus *Megalopa* LEACH, *Megalops* EDW., placed here by LATREILLE between *Galathea* and the preceding genera, must be suppressed; from the observations of THOMPSON and RATHKE it belongs to the earlier forms of brachyurous *Decapods*. The same conclusion is to be formed respecting *Monolepis* SAV.

THOMPSON *Phil. Trans.* 1835, pp. 358—362, Pl. v.; RATHKE *Beitr. z. Vergl. Anat.* 1842, p. 46.

*Galathea* FABR. Middle antennæ short, geniculate, terminated at the apex by two setæ; external long, with elongate, multiarticulate seta, without a scale at the base. First pair of feet large, chelate; fifth pair of feet slender, recurved. Shell ovate, depressed.

*Galathea* and *Grimothea* LEACH.

Sp. *Galathea strigosa* FABR., *Cancer strigosus* L., DESM. *Crust.* Pl. 33, fig. 1, GUÉRIN *Iconogr., Crust.* Pl. 17, fig. 3.

*Æglea* LEACH.

Sp. *Æglea lævis, Galathea lævis* LATR., *Encycl., Hist. nat. Crust.* Pl. 308, fig. 2, DESMAR. *Crust.* Pl. 33, fig. 2.

*Porcellana* LAM. Middle antennæ very short, hidden beneath frons, with double seta, external long, terminated by a multiarticulate seta, and without scale at the base. First pair of feet didactylous, large, depressed, with chela large; fifth pair of feet slender, recurved. Shell depressed, suborbicular. Tail reflected under thorax.

Sp. *Porcellana longicornis* LATR., *Cancer longicornis* PENNANT, *Encycl. méth., Ins. et Crust.* Pl. 275, fig. 3, BELL *Brit. Crust.* Pl. 193; in the Baltic, also on our coasts. This genus forms the transition to the *Decapoda brachyura*. LEACH distinguishes this and some other species of *Porcellana* by the name *Pisidia*, as a separate genus.

Family XXIX. *Loricata* (*Locustæ* LATR.). Four antennæ inserted almost in the same transverse line, middle filiform, bisetose at the apex, external without scale at the base. Feet monodactylous, subequal. Sternum broad posteriorly. Shell hard.

*Palinurus* DALD., FABR. External antennæ setaceous, very long, thick at the base, aculeate. Shell muricate. Eyes large, approximate.

To this genus belong different species of large crustaceans, which inhabit rocky places in various seas. In the Mediterranean is found *Palinurus vulgaris* LATR., *Cancer homarus* L. (excl. Synon.), DESMAR. *Crust.* Pl. 32; the Greeks named this animal *καραβός*, the Romans *locusta*, from which the French name *langouste* is derived. The flesh and also the eggs of these crays are renowned as delicacies. Amongst the exotic species, there are many of which the internal antennæ have two long filaments, as *Palinurus guttatus* LATR., *Encycl., Ins. et Crust.* Pl. 315, from the West Indies, *Pal. japonicus* V. SIEBOLD, DE HAAN *Faun. japon., Crust.* Tab. 41, 42, &c.

*Scyllarus* FABR. Lateral antennæ without filament, peduncles with joints foliaceous, plane, broad. Eyes mostly very remote. Fifth pair of feet in females subchelate, with two small fingers.

Sp. *Scyllarus arctus* FABR., *Cancer arctus* L. (excl. Synon.), SULZER *Gesch. der Ins.* Tab. 32, fig. 3, CUV. *R. Ani., éd. ill., Crust.* Pl. 45, fig. 1; in the Mediterranean. In *Scyllarus orientalis* FABR., the eyes stand still further apart, entirely at the margin of the shell, which is very broad forwards and becomes narrower backwards. RUMPH. *Amb. Raritk.* Tab. II. fig. D, DESMAR. *Crust.* Pl. 31, fig. 1. This species forms the genus *Thenus* LEACH. In some species from foreign seas the eyes are placed more in the

middle of the shell, and this is very broad, and incised deeply on each side. They form the genus *Ibacus* LEACH; to it belongs *Scyllarus antarcticus* FABR., RUMPH. l. l. fig. c.

Family XXX. *Anomura* (*Anomala* LATR.). Four antennæ inserted nearly in the same transverse row, or middle superior; external antennæ without scale at the base. Eyes placed on a petiole, very often elongate. Two or four posterior feet less by far than the rest. Abdominal feet imperfect, small, deficient in some of the segments. Lateral appendages of penultimate segment of abdomen reflected at the sides, never composing a flabelliform pinna.

Phalanx I. *Pagurina* (*Paguridæ* BELL). First pair of feet didactylous, chelate. Appendages of penultimate segment of abdomen short, composed mostly of two parts, incurved, inserted on a short peduncle, not foliaceous. Integuments of abdomen often soft, membranous.

*Pagurus* DALD., FABR. Abdomen contorted, membranous, supplied with thin calcareous laminæ scattered in the back. Fourth and fifth pairs of feet very short, subequal.

*Pagurus* LATR. Middle antennæ short, with two very short terminal setæ.

Sp. *Pagurus Bernhardus* FABR., *Cancer Bernhardus* L., SWAMMERDAM *Bijbel der Nat.* Tab. XI. DESMAR. *Crust.* Pl. 30, fig. 2, the *hermit-crab;* lives in different turbinated shells, when full-grown in the shell of *Buccinum undatum.*

*Note.*—Add genus *Cancellus* EDW.

Compare MILNE EDWARDS *Observations sur les Pagures,* &c., *Ann. des Sc. nat.* 2e Série VI. 1836, *Zool.* pp. 257—288, Pl. 13, 14; ejusd. *Sur quelques nouvelles espèces du genre Pagure, Ann. des Sc. nat.* 3ième Série X. 1848, *Zool.* pp. 59—64.

*Cœnobita* LATR. Middle antennæ long, with peduncle elongate and two unequal setæ, one of them long.

Sp. *Cœnobita Diogenes* LATR., *Encycl. méth., Crust.* Pl. 284, figs. 2, 3, EDWARDS *Hist. nat. des Crust.* Pl. 22, figs. 11—13.

*Birgus* LEACH. Abdomen broad, covered above by a tabulate calcareous crust, membranous below. Fourth and fifth pairs of

feet chelate, unequal, the last much smaller. Middle antennæ elongate, with two unequal setæ at the apex.

Sp. *Birgus latro, Pagurus latro* FABR., DESMAR. *Crust.* Pl. 30, fig. 3.

Phalanx II. *Hippoidea.* First pair of feet monodactylous or subchelate. Four or six following feet with last joint pinniform, lamellose. Fifth pair of feet short, thin, incurved. Penultimate segment of tail with two appendages on each side lamellose, oval, ciliate. Shell oblong.

*Hippa* FABR. (exclusive of some species). External antennæ very long, terminated by a multiarticulate ciliated seta. First pair of feet with terminal joint lamelliform.

Sp. *Hippa emerita, Cancer emeritus* L., DESMAR. *Crust.* Pl. 29, fig. 2, on the coast of Brazil.

*Remipes* LATR. Middle antennæ bisetose at the apex, longer than external. First pair of feet long, with last joint acuminate.

Sp. *Remipes testudinarius* LATR., *Hippa adactyla* FABR., CUV. *R. Ani. éd.* 1. Pl. 12, fig. 2, DESMAR. *Crust.* Pl. 29, fig. 1, from the coast of New Holland.

*Albunea* DALD., FABR. (in part). Middle antennæ longer than external, terminated by a single seta, very long. Anterior feet subchelate, with moveable finger incurved. Shell oblong, with anterior margin broader, almost straight.

Sp. *Albunea symnista* FABR., DESMAR. *Crust.* Pl. 29, fig. 3, GUÉRIN *Iconogr., Crust.* Pl. 15, fig. 1, from the Indian Ocean.

Section II. *Decapoda brachyura* (*Kleistagnatha* FABR.). Tail or posterior part of abdomen small, reflected forwards, almost always received in a furrow of sternum, not terminated by a pinna, with appendages filiform, in females oviferous, not natatory. Third pair of maxilliform feet broad, covering the cibarious organs. Vulvæ mostly situated in sternum, between the bases of third pair of feet.

Antennæ short; middle received in a furrow under the anterior margin of shell in most, terminated by a double subulate seta.

A. Two or four last feet inserted towards the back, not in the same plane with anterior feet.

Family XXXI. *Notopoda* LATR.

† *Vulvæ at the base of third pair of feet.*

*Ranina* LAM. (Species of *Albunea* FABR.). Antennæ short. Shell oblong, oval or obtrigonal. Chelæ compressed. Tail short, extended.

Sp. *Ranina dentata* LATR., *Cancer raninus* L., RUMPH. *Amb. Rariteitk.* Tab. VII. fig. T, V, GUÉRIN *Iconogr., Crust.* Pl. 14, fig. 3, DE HAAN *Crust., Faun. Jap.* Tab. XXXIV. XXXV. figs. 1—4; from the Island of Mauritius to Japan.

*Note.*—Add genera: *Notopus* DE HAAN (*Notopus dorsipes* from which *Raninoïdes* EDW. scarcely differs), *Ranilia* EDW. and *Lyreidus* DE HAAN.

*Homola* LEACH. External antennæ terminated by a long seta, middle not received in a sulcus of frons. Shell oblongo-quadrate, spinose. Tail inflected beneath. Feet elongate; fifth pair of feet dorsal, subcheliform.

Sp. *Homola spinifrons* LEACH, DESMAR. *Crust.* Pl. 17, fig. 1, from the Mediterranean. This genus, like the preceding, has alliance with *Hippa.*

*Lithodes* LATR. Shell obcordate, anteriorly rostrate, aculeate and tuberculate. External antennæ terminated by a long seta. Tail inflected beneath. Second, third and fourth pairs of feet long, spinose; fifth pair of feet minute, almost hidden under the posterior margin of shell, cylindrical, with apex didactylous, obtuse.

Sp. *Lithodes arctica* LAM., *Cancer maja* (excl. Syn.) PONTOPPIDAN *Norges Naturl. Hist.* II. p. 286 (with fig. at p. 276), HERBST *Krabben*, Tab. XV., DESMAR. *Crust.* Pl. 25. This species, living in the North Sea, is named *Troldkrabbe, Devil's Crab.* The feet measure fully 2 feet, although the shell is not larger than 5 inches.

*Droma* DALD., FABR. Internal antennæ received in sulcus of frons. Shell orbicular, very convex. Feet short or moderate; four or more rarely (*Dynomene* LATR.) two last dorsal, subcheliform at the apex.

Sp. *Dromia Rumphii, Cancer Dromia* L., RUMPH. *Amb. Rariteitk.* Tab. XI. fig. 1;—*Dromia nodipes* LATR., GUÉRIN *Iconogr., Crust.* Pl. 14, fig. 66, &c. These crustaceans seize with their hind feet, which are placed on the back, different objects met with in the sea, *Alcyonidiæ*, sponges, &c., and fix them as a covering on the shell.

†† *Female orifices of generation in the middle of sternum, between the bases of third pair of feet.*

*Dorippe* DALD., FABR. Shell depressed, anteriorly narrower, truncated. Second and third pairs of feet very long, with last joint long, subulate; fourth and fifth pairs dorsal, short, subcheliform. Tail inflected downwards.

Sp. *Dorippe lanata* BOSC, *Cancer lanatus* L., DESMAR. *Crust.* Pl. 17, fig. 2; from the Mediterranean.

B. Feet all in the same horizontal plane inserted at the inferior surface of sternum. Tail always inflected downwards.

† Area of mouth (space bounded by the third pair of maxilliform feet) triangular, anteriorly narrower, often produced almost as far as the anterior margin of shell. Third pair of maxilliform feet slender or narrowed anteriorly, triangular.

Family XXXII. *Oxystomata* EDW. (in part).

*Corystes* LATR. External antennæ setaceous, ciliated, very long. Shell oblong, oval. First pair of feet cheliform, the rest with last joint subulate, acute, elongate.

Sp. *Corystes dentatus, Albunea dentata* FABR., DESMAR. *Crust.* Pl. 3, fig. 2, BELL *Brit. Crust.* p. 129, buries under the sand, sending out the antennæ alone above it; the males have shears of twice the length of the body. This species is found on the English and French coasts.

*Atelecyclus* LEACH.

Add genus *Thia* LEACH and some others, on which see MILNE EDWARDS *Hist. nat. des Crust.* II. pp. 141—151.

*Leucosia* FABR., LATR. External antennæ very small, internal concealed in little pits. Eyes minute. Shell solid, mostly rotundato-ovate. Branchial cavity closed below, no fissure at the bases of maxilliform feet. Tail with four or three segments.

Several sub-genera proposed by LEACH: *Iphis, Nursia, Persephona, Ixa, Philyra, Ebalia, Myra, Ilia.* Add *Oreophorus* RUEPP.

*Note.*—Here also *Bellia* EDW., a new genus, seems to be referrible. See *Ann. des Sc. nat.*, 3ième Série, Tom. IX. 1848, *Zoolog.* p. 192.

Sp. *Leucosia craniolaris* FABR., DESMAR. *Crust.* Pl. 27, fig. 2.

*Hepatus* LATR.

*Matuta* FABR. Antennæ short, external minute. Two anterior feet short, with chela concave internally, crested above; remaining

feet with last joint lamellose, lanceolate or oval. Shell suborbicular, with anterior margin dentate, with a strong spine on each side produced above the second pair of feet.

Sp. *Matuta victor* FABR., RUMPH, *Amb. Rariteitk.* Tab. VII. 8, DESMAR. *Crust.* Pl. 7, fig. 5; in the Indian Ocean, also in the Red Sea.

*Orithyia* DALD., FABR. Shell muricate oval, truncated anteriorly. Fifth pair of feet terminated by an oval lamina.

Sp. *Orythia mamillaris* FABR., DESMAR. *Crust.* Pl. 19, fig. 1, GUÉRIN *Iconogr., Crust.* Pl. 1, fig. 2; from the Indian Ocean and the coast of China.

*Mursia* LEACH.

*Platymera* EDW.

*Calappa* DALD., FABR. External antennæ short, with basal joint broad. Shell short, convex, broader posteriorly, covering with its margin produced the contracted feet. First pair of feet with chelæ large, compressed, crested above, with inner concave side excised at the outer margin of shell. Remaining eight feet with last joint styliform.

Sp. *Calappa granulata* FABR., *Cancer granulatus* L. (excl. Synon.), HERBST *Krabben* I. Tab. 12, figs. 75, 76, CUV. *R. Ani., éd. ill., Crust.* Pl. 38, fig. 1, from the Mediterranean;—*Calappa tuberculata* FABR., DESMAR. *Crust.* Pl. 10, fig. 1; Red Sea, Indian Ocean, &c.

*Note.*—Add sub-genus *Camara* DE HAAN. Sp: *Calappa fornicata, Cancer calappa* L.

†† Area of mouth quadrate, anteriorly remote from the margin of shell. Maxilliform feet broad.

Family XXXIII. *Majacea* DE HAAN, *Oxyrhyncha* EDW. Space between the origin of middle antennæ and the area of mouth large, scarcely broader than long. Shell triangular or subovate, anteriorly narrowed, mostly running into a frontal rostrum. Feet mostly elongate, never natatory.

*Inachus* FABR. (in part). Feet slender, very long, elongate; second pair very often longer than first. Third joint of maxilliform feet obtrigonal or obovate, sustaining the fourth on its apex.

*Leptopodia* LEACH. Rostrum very long. Peduncle of eyes short.

Sp. *Inachus sagittarius* FABR., DESMAR. *Crust.* Pl. 16, fig. 2, GUÉRIN *Iconogr., Crust.* Pl. 11, fig. 4; from the West Indies.

*Note.*—Genus *Pactolus* LEACH to be obliterated; comp. DE HAAN *Fauna Japon., Crust.* p. 89.

*Latreillia* ROUX. (Is this its place?)

*Stenorhynchus* LAM.

*Inachus* LEACH. Peduncles of eyes capable of concealment backwards in a pit. Rostrum short. First pair of feet in males longer than shell, in females short.

Sp. *Inachus Scorpio* FABR., *Cancer Dorsettensis* PENN., DESMAR. *Crust.* Pl. 24, fig. 1, BELL *Brit. Crust.* p. 13; in the North Sea and the Atlantic ocean.—*Inachus leptochirus* LEACH, BELL l. l. p. 18.

*Macrochira* DE HAAN. Shell cordate, posteriorly broad, tuberculate and spinose, with rostrum bifid, and horns diverging. Chelæ cylindrical, in adult males surpassing in length the second feet. Tail with seven segments in both sexes.

Sp. *Inachus Kœmpferi* DE HAAN, *Faun. Japon., Crust.* Tab. 25—28, a very interesting crustacean which, according to the characters of the oral organs belongs to *Inachus*, but by its size and by the long fore-feet or shears in the male differs from it. These may attain the length of 4 feet, and the thickness of the thigh-bone of a man, as was already figured by KÆMPFER, *Beschrijv. van Japan*, Amsterd. 1733, fol. p. 100, Pl. XIV, A.

*Camposcia* LATR., *Oncinopus* DE HAAN, *Eurypodius* GUÉRIN, *Achæus* LEACH, *Microrhynchus* BELL. Here also DE HAAN refers genus *Halimus* LATR., resembling the *Majæ* and *Pisæ*.

Sp. *Halimus aries* LATR., GUÉRIN *Iconogr., Crust.* Pl. 9, fig. 2.

*Egeria* LATR. Feet slender, very long; second pair longer than first. Third joint of maxilliform feet quadrate, receiving the fourth joint in the upper margin at the internal angle.

* *Shell triangular, with rostrum two-horned.*

*Eurypodius* GUÉRIN.

** *Shell orbicular, with rostrum short, narrow, the apex entire or emarginate.*

*Doclea* LEACH, *Egeria* LATR., *Libinia* LEACH.

Sp. *Egeria arachnoïdes* LATR., RUMPH. *Amb. Rariteitk.* Tab. VIII. fig. 4; East Indies.

*Maja* LAM. (exclusive of species). Feet moderate, first and second pairs longer. Third joint of maxilliform feet of third pair

quadrate, receiving the fourth joint at the internal angle of the superior margin. External antennæ with seta pretty long, subulate, with elongated joints, first joint large, grown to the shell, with the external margin shutting in the orbit beneath. Shell mostly longitudinally triangular, or oval, spinose, with rostrum bicornute. Abdomen in most composed of seven segments.

*Pisa* LEACH (and *Lissa* ejusd.). Add sub-genera: *Hyas* LEACH, *Mycippa* LEACH, *Leucippa* EDW., *Pericera* LATR., *Herbstia* EDW.

Sp. *Hyas araneus* LEACH, *Cancer araneus* L., CUV. *R. Ani., éd. ill., Crust.* Pl. 33, fig. 2, BELL *Brit. Crust.* p. 31.

*Maja* LAM. (exclusive of several species). Add sub-genera: *Acanthonyx* LATR., *Chorinus* LEACH, *Mithra* LEACH and some others. Comp. DE HAAN l. l. pp. 81–83.

Sp. *Maja squinado* LATR., *Cancer squinado* HERBST, DESMAR. *Crust.* Pl. 21, BELL *Crust.* p. 39; on the S. and W. coasts of England, in the Mediterranean, &c.

*Parthenope* FABR. First pair of feet very long, geniculate at the chela, remaining feet moderate. (Third joint of maxilliform feet as in *Maja*.) Basal joint of external antennæ not concrete with shell, not closing the orbit. Shell mostly triangular, often broader than long, tuberculate. Rostrum short.

*Parthenope* FABR., LEACH (and *Larabius* LEACH).

Sp. *Parthenope horrida, Cancer horridus* L., RUMPH. *Amb. Rariteitk.* Tab. IX., DESMAR. *Crust.* Pl. 20, fig. 1; from the Indian Ocean.

*Œthra* LEACH, LAM.

*Cryptopodia* EDW.

*Note.*—These sub-genera, scarcely distinct, differ from *Parthenope* in the feet, as in *Calappa*, concealed under the shell.

Family XXXIV. *Cancrina* (*Arcuata* and *Quadrilatera* LATR., *Catometopa* and *Cyclometopa* EDW.). Space between the origin of middle antennæ and area of mouth short, transverse, much broader than long. Shell never running anteriorly into a frontal rostrum.

A. *Fourth joint of maxilliform feet placed upon the middle apex or the external angle of third joint.*

*Shell mostly subquadrate or trapeziform, with frons declining or perpendicularly inflected.*

*Pinnoteres* LATR. Shell orbiculate. Peduncles of eyes short. Chelæ short, thick.

Sp. *Pinnoteres pisum* LATR. (and *Pinn. mytilorum* ejusd.), *Cancer pisum* L., FABR., BASTER *Natuurk. Uitsp.* II. Tab. IV. figs. 1, 2, CUV. *R. Ani., éd. ill., Crust.* Pl. 19, fig. 1, BELL *Brit. Crust.* p. 121; in mussels. Another species, *Pinnoteres veterum* BOSC, lives in *Pinna* and was supposed by the ancients to warn this bivalve against impending danger (see CICERO *de Finib. mal. et bon.* III. Cap. 29, the mid.).

The females are larger, have a broader shell and especially a much broader tail than the males.

Sub-genera: *Xanthasia, Pinnixa* WHITE, *Ann. of nat. Hist.* XVIII. pp. 176, 177.

*Grapsus* LAM. Shell depressed, subquadrate, with frons broad and lateral margins almost straight. Eyes placed at the lateral angles of shell upon short thick peduncles. Middle antennæ horizontal, concealed under the reflected frons. First pair of feet short.

Sp. *Grapsus pictus* LATR., *Cancer grapsus* L., DESMAR. *Crust.* Pl. 16, fig. 1, CUV. *R. Ani., éd. ill., Crust.* Pl. 22;—*Grapsus variegatus* LATR., *Canc. varieg.* FABR., GUÉRIN *Iconogr., Crust.* Pl. 6, fig. 1.

Add genera: *Sesarma* EDW. (*Pachysoma* DE HAAN), *Varuna* EDW. (*Trichopus* DE HAAN), *Pseudograpsus* EDW. and some others, which must be here omitted.

*Gecarcinus* LEACH. Shell cordate, anteriorly broader, turgid, posteriorly truncated. Peduncles of eyes short, received in rounded furrows.

Sp. *Gecarcinus ruricola, Cancer ruricola* L., DESMAR. *Crust.* Pl. 12, fig. 2, &c.; from S. America.

This genus contains the so-called *land-crabs*, that live in woods. Some betake themselves at a certain time of the year to the sea to lay their eggs, and undertake the journey in large troops, as travellers relate, in a straight line, from which they cannot be turned by any opposition.

*Plagusia* LATR. Frons excised on both sides for middle antennæ denuded above, porrect. Shell broad, narrowed anteriorly. First pair of feet short.

Sp. *Plagusia clavimana*, DESMAR. *Crust.* Pl. 14, fig. 2, &c.

*Ocypode* FABR. Shell quadrate or trapeziform, anteriorly broader. Middle antennæ short, with two very small setæ; lateral antennæ small. Eyes placed on long peduncles. Chela in males often very large on one side, far surpassing the chela of the other side.

*Gelasimus* LATR. Peduncles of eyes slender, cylindrical, with eyes terminal. Shell broader than long, trapeziform.

Sp. *Gelasimus vocans, Cancer vocans* L., DE GEER *Mém. p. s. à l'Hist. des Ins.* VII. Pl. 26, fig. 12, from the coast of Brazil. Comp. LINN. *Amœn. Acad.* VI. p. 414;—*Gelasim. Marionis* DESM. *Crust.* Pl. 13, fig. 1, &c.

*Ocypode* LATR. Peduncles of eyes acuminate, with a horn produced beyond the eyes. Shell subquadrate.

Sp. *Ocypode ceratophthalma* FABR., *Cancer cursor* L., PALLAS *Spicil. Zool.* IX. p. 83, Tab. V. figs. 7, 8, DESMAR. *Crust.* Pl. 12, fig. 1; from the Red Sea and the Indian Ocean.

Add genera *Uca* LEACH, *Cardisoma* LATR., *Macrophthalmus* LATR., *Cleistostoma* DE HAAN, *Hymenosoma* LEACH, *Myctiris* LATR., *Doto* DE HAAN, &c. Comp. DE HAAN *Faun. Japon., Crust.* p. 5, pp. 24—30. Here also belongs genus *Halicarcinus* WHITE.

B. *Fourth joint of maxilliform feet placed on the inner angle of third joint.*

*Shell mostly arcuate anteriorly, with margin convex, truncated posteriorly.*

*Telphusa* LATR. Shell depressed, smooth, cordate, broad. External antennæ very short, inserted near the peduncles of eyes.

Sp. *Telphusa fluviatilis* LATR., *Crabe de rivière* OLIVIER, *Voyage dans l'Empire Othoman*, Pl. 30, fig. 2, DESMAR. *Crust.* Pl. 15, fig. 2; in fresh water in the south of Italy, Greece, Egypt, &c.

Here belong also the genera *Boscia* EDW. and *Trichodactylus* LATR.

*Eriphia* LATR. Shell cordate or trapeziform. External antennæ exsert, remote at their insertion from the petioles of eyes.

Sp. *Eriphia spinifrons* LATR., *Cancer spinifrons* HERBST, FABR., DESMAR. *Crust.* Pl. 14, fig. 1.

Add genera *Ruppellia* EDW., (*Eudora* DE HAAN), *Trapezia* LATR.

*Cancer* FABR. (species from *Cancer* L., *div. brachyur.*). Shell broad, anteriorly arcuate, gibbous. Chelæ thick. Eight remaining feet with last joint styliform, not natatory. Third joint of maxilliform feet of third pair quadrate.

Sp. *Cancer pagurus, Platycarcinus pagurus* LATR., EDW., DESMAR. *Crust.* Pl. 8, fig. 1; BELL *Brit. Crust.* p. 59; the *common sea-crab;* 6 inches broad or broader, the shell reddish brown, granularly uneven and on each side with nine incisures or grooves; the shears smooth and, as in other species of this division, black at the point; this species is edible and very tasty.

Compare on this genus TH. BELL *Observations on the genus Carcinus &c. Transact. of the Zool. Soc.* I. 4, 1835, pp. 335—342, Pl. 43—47.

Add genera: *Gonoplax* LEACH, *Pilumnus* LEACH, *Xantho* LEACH, and some others proposed by DE HAAN.

*Portunus* DALD., FABR. Shell depressed, posteriorly truncated, mostly transverse, broader than long. Two last feet natatory, with tarsus depressed, flat.

A. *Two posterior feet alone natatory.*

*Carcinus* LEACH. Tarsus of fifth pair of feet narrow, lanceolate. Petioles of eyes short.

Sp. *Carcinus mœnas, Cancer mœnas* L., BASTER *Natuurk. Uitsp.* II. Tab. II., BELL *Brit. Crust.* p. 76; the *shore-crab*; forward between the eyes the shell has three points, and on each side at the margin five triangular teeth. This crab is very common on our shores.

*Portunus* LEACH. Tarsus of fifth pair of feet dilated, oval. Petioles of eyes short.

Add sub-genus *Thalamita* LATR. and genus *Lupa* LEACH in part.

Sp. *Portunus puber* LEACH, *Cancer puber* L., DESMAR. *Crust.* Pl. 5, fig. 1, BELL. *Brit. Crust.* p. 90.

*Podophthalmus* LAM. Tarsus of fifth pair of feet dilated, oval. Peduncles of eyes cylindrical, very long, produced as far as the angles of shell, received in a canal in the margin of shell. Shell short, transverse, depressed, on both sides at the anterior angle bi-spinose.

Sp. *Podophthalmus spinosus* LAM., LATR.; *Portunus vigil* FABR. *Suppl. Entom. syst.* p. 363, DESMAR. *Crust.* Pl. 6, fig. 1, GUÉRIN *Iconogr., Crust.* Pl. 1, fig. 3; from the Indian Ocean.

B. *Four pairs of feet natatory, with tarsus foliaceous.*

*Platonychus* LATR. (and *Polybius* LEACH, and species of genus *Lupa* LEACH, sub-genus *Neptunus* DE HAAN).

Sp. *Polybius Henslowii* LEACH, DESMAR. *Crust.* Pl, 7, fig. 1, BELL *Brit. Crust.* p. 116.

*Lupa pelagica* LEACH, *Cancer pelagicus* L., RUMPH. *Amb. Raritcitk.* Tab. VII. fig. R, DESMAR. *Crust.* Pl. 6, fig. 2, DE HAAN *Crust. Jap.* Pl. IX. X.; this beautiful species with smooth shell running into a sharp point on each side between the second and third pairs of feet, is found in the Red Sea, the whole Indian Ocean, and especially on the coast of Japan, where it is very common, and a favourite food of the natives.

# ON MOLLUSCS IN GENERAL[1].

In what precedes we have treated of the greater part of those animals that have no internal skeleton or no vertebræ. There still remain however for our consideration many that, in the system of *Linnæus*, were referred to the class of worms, but which by CUVIER were, first as a class, afterwards as a larger group constituting a primary form (*typus*), collected together and separated from the rest of the worms[2]. Since they do in reality form such a group, which

[1] Compare on this division of the Animal Kingdom, amongst others:

M. LISTER *Exercitatio anatomica de Cochleis maxime terrestribus et Limacibus.* Londini, 1694, 8vo.

Ejusd. *Hist. sive Synopsis method. Conchyliorum et Tabularum anatomicarum editio altera. Recensuit et indicibus auxit* G. HUDESFORD, Oxonii, 1770, folio.

M. ADANSON *Hist. natur. du Sénégal. Coquillages. Avec* 19 *pl.* Paris, 1757, 4to.

J. X. POLI *Testacea utriusque Siciliæ eorumque historia et anatome, Tabulis æn. illustrata.* Parmæ, fol. Tom. I. 1791, Tom. II. 1795, Tom. III. *Pars prima posthuma; edid.* S. DELLE CHIAJE, Parmæ, 1826, *Pars altera, auctore* S. DELLE CHIAJE, Parmæ, 1827 (this part remains unfinished).

CUVIER *Mémoires pour servir à l'Histoire et à l'Anatomie des Mollusques,* avec 35 Pl. Paris, 1817, 4to.

E. FORBES and S. HANLEY *Nat. Hist. of British Mollusca and their Shells.* London, 1848—50, 8vo.

G. JOHNSTON *An Introd. to Conchology; or Elements of the natural Hist. of Molluscous Animals.* London, 1850, 8vo.

As manuals the following especially may be consulted:

LAMARCK *Hist. nat. des Animaux sans Vertèbres, 2e édit. par* DESHAYES *et* MILNE EDWARDS, Tom. VI. 1835; H. DUCROTAY DE BLAINVILLE *Manuel de Malacologie et de Conchologie,* 1 Vol. 8vo, Paris et Strasbourg, 1825—1827, avec 107 *Planches,* and G. P. DESHAYES *Traité élémentaire de Conchologie,* Paris, 1838 and foll. 8vo. (hitherto only 9 numbers have appeared). We shall principally refer to these two last works, besides GUÉRIN'S *Iconographie,* for the figures, and only occasionally quote more extensive works of plates, as those of MARTINI and CHEMNITZ, KIENER, &c.

[2] See p. 33 and 208. To the works of CUVIER referred to in the last of these pages, there ought to have been added one that was printed separately from the *Decade philosophique,* a journal with which I am not further acquainted, and which now lies before me: it is entitled, *Mémoire sur la structure interne et externe et sur les*

may be compared with that of the vertebrate animals, to which four classes belong, it is not inexpedient, before we pass to the consideration of the different classes which have here, with more or less propriety, been adopted, to indicate the common characters which distinguish the molluscs from the rest of the worms.

The body of these animals is covered by a skin, soft and constantly moist, to which the muscles are attached, and in which or on which a calcareous secretion is usually effected. The external integument, which indeed has also been named mantle (although properly a free production on the dorsal surface ought alone to bear that name), encloses as well the intestines as the nervous system also. The central parts of this nervous system consist of ganglia, which either form a ring round the œsophagus or lie more dispersedly, but not behind each other in a row on the abdominal surface, as is the case in the insects. The molluscs ordinarily present a much less similarity of the right and left half of the body than the articulate animals already reviewed by us, or the vertebral animals to be considered in the sequel. Many have no head distinct from the rest of the body. The organs of sense are on the whole slightly developed. In the most composite molluscs however, in the *Sepiæ* and other Cephalopods, there are found not only two highly developed eyes, but also rudiments of auditory organs. The movements are on the whole creeping and slow. Some, that live in water, are immoveably attached to different objects. Many headless bivalve molluscs have indeed a springing motion, yet this is in a far less degree successive than in articulate animals.

The inferior degree of development of the organs of animal life is the cause that many writers of the present day, as LINNÆUS formerly, still place the molluscs lower than the insects in the arrangement of the animal kingdom.

More perfect than the organs of animal life are those of the vegetative, those for secretion, nutrition, and propagation. The respiratory organs are usually gills. In most molluscs a heart is present, which receives the arterial blood from the organs of respiration, and distributes it by arterial tubes to the different parts of

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*affinités des animaux auxquels on a donné le nom de Vers.* From this memoir read in 1795 before the *Soc. d'Hist. nat.* of Paris, it appears that even thus early the class of the molluscs was distinguished by CUVIER and defined as in his later works.

the body. Capillaries are wanting, and the veins are replaced by sinuses, which have no proper walls, but are excavated in the different parts of the body. The blood of molluscs is commonly white or whitish blue. Some molluscs are bisexual, and require mutual impregnation; in others the sexes are distinct. The most are oviparous. The eggs are surrounded by a thin shell (*Chorion*), between which and the yolk in some an albuminous fluid is interposed, and which is sometimes horny, and but seldom covered with calcareous incrustation. Often the eggs, when laid, are connected in bunches, or adhere to each other by a gelatinous mass. The number of species that live on land is small in comparison of the much greater quantity of species that live in fresh, and especially in salt water.

Before we proceed to the division of the molluscs, we would treat shortly of the shells which cover the body in most. The univalve shells are called *cochleæ*, the bivalve, as those of mussels, *conchæ*. There are also some molluscs that are covered by many pieces of shell. Such a multivalve shell (*testa multivalvis*) has the genus *Chiton*, where transverse calcareous plates, lying behind one another in a row, cover the back. The bivalve shells are thicker at the part where they are connected with each other. This part is named the *point* (*apex*). At the point there are on the margin, within the shell, usually projections and hollows, which mutually fit into each other, and to which the name of hinge (*cardo*) is given. When this margin is smooth, there is said to be no hinge (*testa acardis*). In front of the point a slight depression is seen on the shell, which is named the male depression (*lunula*, by LINNÆUS *anus*); behind the point is a chink, ordinarily smaller and more elongate, the *fissure* (*fissura*, in French *écusson*, with LINNÆUS *vulva*). On this the *ligament* is usually situated which, formed of elastic horny fibres, runs transversely from one shell to the other. Where this ligament, as in most of the bivalve molluscs, is attached to the outside of the shells, it is obvious that they will be opened by its contraction. Yet even where the ligament is placed internally the two shells are separated from each other by its elasticity, because in this case the fibres are forcibly compressed by the shell when closed. In those bivalve molluscs which move freely, the opening of the shell is turned downwards, the point upwards, and the ligament backwards. LINNÆUS, in his description, placed the bivalve shell with its point

downwards, and turned the ligament forwards. BLAINVILLE, on the contrary, described it in the position which we have indicated[1].

In the univalves (*cochleæ, testæ univalves, subbivalves*) the following parts may usually be distinguished. The extremity of the spire is called the *point* (*apex*), which, when the animal is alive and in motion, is turned upwards and backwards. Ordinarily the cavity of the shell terminates in a point at this part, but it is sometimes truncated horizontally (*apex decollatus* s. *truncatus*), which must not be mistaken for an accidental fracture which always leaves an opening. In some univalve shells (as in the genus *Patella*), the cavity between the point and the aperture is neither twisted to the right or left, nor forwards or backwards. In most, on the other hand, this cavity is turned. Usually all the turns run obliquely from above downwards (*turbinated shells, cochlea turbinata* et *turrita*); yet in some the wreaths or turns run from left to right in a transverse direction, whereby the last wreath includes the rest externally (*testa convoluta* s. *involuta*, the *involute shell*, as in the genera *Conus* and *Oliva*), whilst others again are turned in one and the same vertical plane, from behind forwards and from above downwards (*cochlea revoluta*, as in the genus *Nautilus*).

The opening (*apertura*) of the shell is opposite to the point. That part of the cavity, which is visible within the mouth, is called the *throat* (*faux*). The mouth may be excised with a sinus anteriorly (*apertura emarginata*). Whenever it terminates forwards in a channel (*apertura canalifera*), then the tube is called the *tail* (*cauda* s. *rostrum*). At the mouth the external margin (*labium exterius* s. *labrum*) is distinguished from the internal margin (*labium internum* s. *margo columellaris*). The spindle (*columella*) is that part which runs in the middle of the shell directly from the point to the aperture, and round which, as an axis, the wreaths are turned. Such a calcareous axis is not present in all univalve shells; to see this part distinctly, a shell sawn longitudinally must be provided. At the internal margin of the aperture there is often on the extremity of the spindle, especially in the shells of younger molluscs, a cavity which is called *navel* (*umbilicus*). Shells, in which this aperture is wanting, are named *imperforate* (*cochleæ imperforatæ*).

[1] That which with LINNÆUS is the right and the left shell still preserves this name, since he turned the bivalve not only upside down, but also the fore part backwards.

The internal cavity of the shell may extend uninterruptedly through all the turns (*cochlea monothalamia* s. *unilocularis*), or may be divided by several partitions (*cochlea polythalamia*). A cylindrical tube traversing these partitions is named *siphon* (*sipho*). Such a many-chambered shell is that of the genus *Nautilus*.

*Cover* (*operculum*) is the name given to a round calcareous or sometimes horny lamina, which in many molluscs is attached to the uppermost and hindmost part of the so-named foot, and which, when the animal retracts itself within the shell, closes the aperture. Sometimes a spiral line is seen on this part, as for instance in the genus *Turbo*. Some writers name the shell, in this case, *testa subbivalvis*.

Finally, according to the direction of the wreaths, univalve shells are distinguished as *right-* and *left-turned*. In most of them, when placed on the aperture with the point backwards, the external margin of this is on the right side, and the turns run from the point to the aperture from the left side to the right (*cochlea dextra*). If the converse takes place and the external margin of the aperture lies on the left, then the turns run from the right to the left side (*cochlea sinistra* s. *contraria*), and with this a displacement of the internal organs is connected. Some species of molluscs have such a left-handed shell as the rule, and in others (as in *Helix*) shells of this sort occur as varieties or deviations, just as a displacement of the internal organs, of the heart at the right-side, &c. has been also observed occasionally in man[1].

What has been stated may suffice for the explanation of the most common and necessary terms[2]. But for the general anatomy and physiology it is desirable to contemplate shells in another point of view, and to investigate the mode of their origin and composition.

The formation of shells is effected by the external integument

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[1] On such left-turned snail-shells CHEMNITZ has published various remarks and observations in the Journal *Der Naturforscher* VIII. s. 163—178, XII. s. 76—84. That from the left-handed variety of *Helix Pomatia* right-handed young are again produced, was observed by him with perfect certainty; *ibid.* XVII. s. 1—11.

[2] Comp. A. MURRAY *Fundamenta Testaceologiæ*. Upsaliæ, 1771, 4to, (also transferred to LINN. *Amœnit. Acad.* VIII. pp. 107—150); BLAINVILLE *in Dict. des Sc. nat.* X. pp. 168—225, article *Cônchologie* (and the same writer in his Manual cited above); DESHAYES, article *Coquille, Dictionn. classique d'Hist. nat.* Tome IV. 1823, pp. 431—449, &c.

or mantle of molluscs. RÉAUMUR[1] has illustrated the formation by his experiments. He found, on boring the shells of living snails, the aperture to become closed again by a thin layer occupying the whole of it, to which other layers were afterwards added. Thus there was no calcareous matter secreted at the edge of the aperture by vessels running in the shell, as in the reparation of bones where the formation of new osseous matter proceeds from the extremities of the fractured bones. When, however, RÉAUMUR supposes that the formation of shells is a mechanical transudation, that the secretion of lime on the upper surface of the mollusc may be compared to calcareous incrustations, which in certain waters and springs are formed round bodies immersed in them, that the skin of the animal, like a sieve, permits an adhesive fluid loaded with calcareous particles to escape, and that this fluid by evaporation and rest loses its watery particles, then his representation bears too forcibly the character of off-hand ideas respecting living beings, and POLI is so far justified in calling the origin of shells an organic origin, and in rejecting this mechanical explanation. It is clear that shells by the addition of new laminæ become thicker. In a shell several layers or calcareous scales lie upon each other, which in bivalves originate from the point; hence the shell is, at this part, of greatest thickness, and becomes gradually thinner towards the margin. Thus every shell consists, as it were, of many others, all of which becoming larger and larger, lie under each other, whilst the innermost, the last formed, extends beyond the others at the margin. In oyster-shells and many other bivalves this may be clearly seen; and snail-shells also indicate the same; in younger univalves the number of turns is fewer; the larger shells of the same species present a greater number of wreaths than the smaller, without however those wreaths, that were already present in the young ones, increasing in size. So also the spines, tubercles, and other excrescences of univalves are at first short and obtuse, and become larger and more acute by the addition of new layers. The increase however is not at all times uniform, but in the cold of winter and the great drought of summer

[1] *De la formation et de l'accroissement des coquilles, Mém. de l'Acad. royale des Sc.* 1709, Paris, 1733, pp. 364—400; Paris, 1741, pp. 303—311; comp. also POLI *Testac. utriusque Siciliæ*, Tom. I. (in the introduction) and HEUSINGER *System der Histologie.* Eisenach, 1823, I.-2tes Heft, s. 236—242.

is suspended. Hence stronger stripes arise, which indicate succession in growth, and are the traces left of it.

As to chemical composition, besides some other less constant constituents and a small quantity of phosphate of lime, univalve and bivalve shells consist principally of carbonate of lime and an animal substance, a membranous *substratum*, that remains after the calcareous matter has been dissolved by acid, and is usually very small in quantity compared with the calcareous matter. POLI, when he exposed the membrane to the fire, saw it quickly take flame, on which he perceived a smell like that of burning horn; a spongy carbon remained.

This conducts us to a correct view of the nature of shells, which belong to the same tissue as horn, hair, and in part also scales, *i.e.* to horny tissue. In most animals the dermal skeleton (such is the name given to the hard parts placed *externally*, to which the muscles are attached,) is horny, whilst, on the other hand, cartilage is almost always the foundation of an internal skeleton, especially of a true neural skeleton. The microscopic structure of bivalve and univalve shells has been chiefly illustrated by the investigations of CARPENTER. In some bivalves the entire substance of the shell consists of layers of membrane, without visible cells, in others such a membranous tissue forms the inside of the shell, whilst on the outside columnar, often hexagonal cells are visible under the microscope, which to the naked eye, or with the use of a lens, look like fibres. They stand nearly at right angles on the surface of the shell from within outwards, and are filled with carbonate of lime. In each layer they are at that part only which projects beyond the edge of the preceding layer; thus they have been secreted by the edge of the mantle, whilst the whole mantle, in every new formation of a layer, produces a membrane that covers the inner surface of the entire shell. The univalve shells of the gasteropodous molluscs have only a small quantity of organic substance; in many three layers of plates may be distinguished; the direction of these plates is different, and those of the middle layer intersect those of the external and internal at right angles. Every plate consists of a row of long columns, or prismatic cells, which are arranged side by side[1].

[1] See W. B. CARPENTER *Annals of Nat. History*, Vol. XII. 1843, pp. 377—390, Pl. XIII. XIV. and especially his later, more general investigations, announced in

In many, especially bivalve shells, a horny, brown-yellow outermost covering is found, which has been named *epidermis* or recently *periostracum* also (in French *Drap marin*). Sometimes it is hairy or divided into scales, which however are more apparent at the margin of the shell, having been worn off from the parts previously formed. This membrane has been regarded as a continuation of the cuticle of the mantle, by which this is connected with the margin of the shell. More correctly, perhaps, this covering may be explained from a confluence of the intercellular matter, a residuum of the formless homogeneous substance (the *cytoblastema*)[1], in which the cells filled with lime were formed. Let it be supposod that at the outer margin of every layer this substance remains without cells, and consequently hardens like horn. If these edges should close upon each other, then a smooth *epidermis* will arise; if they should remain more distant from each other, then a scaly, flocculent or hairy covering will be formed.

The colours, presented by bivalve and univalve shells, are deposited only in their outermost parts, the inner layers are white. This may be explained by the circumstance, that the colouring matter is secreted especially by the edge of the mantle. But the mantle grows with the animal, and thus each succeeding layer of the shell is coloured at its outer margin alone, whilst its remaining portion, secreted by the rest of the surface of the mantle, remains white. In this way a series of coloured edges arises, which, closing upon each other, form the outermost coloured surface of a shell. There are however some univalves (the genus *Cypræa* and some *Olivæ*) in which, when full grown, the colours are deposited not on the surface alone, but also in a deeper layer, whilst at the same time the superficial and the more deeply lying colours are different. These molluscs are at first covered with a thin shell, of which the colours must be ascribed to the edge of the mantle. As the animal grows, lateral appendages of the mantle are developed, which throw themselves like wings over the shell, and secrete on their outer

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*Reports of the British Association* for 1844 and 1847. The chief particulars of these investigations may be also found in the Article *Shell* by the same writer in Todd's *Cyclopædia*, IV. 1849, p. 556, &c.

[1] Page 17, 18.

surface a calcareous layer as hard as ivory and of a different colour, which covers the preceding layers[1].

Many bivalve and univalve shells have on their inner surface lively and glancing colours, which must not be confounded with the external colours. They are the play of colours from the refraction which is seen to arise on the transmission of white light through a prism, and which causes the beautiful phenomenon of the rain-bow. The *mother of pearl* therefore is not to be ascribed to any special colouring matter, but to very fine streaks and folds of the internal membrane of the shells[2]. It continues even after the carbonate of lime has been removed by an acid, and CARPENTER observed that the play of colour disappeared when he extended the membrane with needles so that the folds were obliterated[3]. These changes of colour are particularly beautiful in the genus *Haliotis*, a species of which is used by the *Japanese* to ornament the lackered furniture of their houses.

Whenever the fluid, which forms this innermost layer of bivalves, is effused in the form of small drops, *pearls* arise, which have frequently a very irregular shape. These may accordingly exist in very different species of bivalves, also in turbinate univalves; yet they arise usually in bivalves, and especially in *Meleagrina margaritifera* and *Unio margaritiferus*. The former species of conchifer is fished in the Persian gulph, the last is found in fresh water in different parts of Europe, and also in our country. According to HOME, pearls have undeveloped eggs for a nucleus, which have remained accidentally on the outside of the mantle within the shell. Such may often be the case, but there is no

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[1] BRUGUIÈRE in the *Journal d'Hist. Nat.* I. 1792, pp. 307—315, quoted by SCHWEIGGER *Handb. der Naturgesch. der skelettlosen ungeglied. Thiere*, s. 681. A different opinion of BRUGUIÈRE, that the animal of *Cypræa* leaves its shell, and forms a new one, though adopted by LAMARCK and SCHWEIGGER, can no longer be defended; compare DESHAYES in the new edition of LAMARCK *Hist. nat. des Animaux s. Vertèbres*, X. p. 485.

[2] This was first announced by BREWSTER *Phil. Trans.* 1814. If a drop of sealing-wax be allowed to fall on a mother of pearl shell, the surface of the wax, which has been in contact with the shell, presents the same colours. It may be supposed that this was an impression of the surface. But it appears, that in this experiment a thin scale of the surface of the shell remains adhering to the wax.

[3] *Annals of Nat. Hist.* XII. p. 382.

reason why the formation of pearls should not be ascribed also to other irritants affecting the mantle. It has been observed at least that injuries of the shells and wounds, caused by boring worms, have had the production of pearls for a consequence; and the secret of LINNÆUS for favouring the production of pearls (in *Unio*), consisted, most probably, in boring the shell in different places in conchifers, which were submitted to these experiments[1].

The shells of molluscs, from their variety of colour and form, constitute no small part of the ornament of natural-history collections. The knowledge of conchology is of the highest interest to the Geologist, since the petrified and extinct species afford important characters for distinguishing the different strata. But, more than this, the knowledge of the molluscs is of great value to general physiology. To the celebrated Danish zoologist of the last century, O. F. MUELLER, the honour is principally due of having raised this part of natural history from the fondness of collectors to the scientific contemplation of naturalists; it was his impressive exhortation that thenceforward attention should not be confined solely to the *house* or the shell, but, above all, be extended to an accurate investigation of its inhabitant[2]. Already had SWAMMERDAM in Holland, and MARTIN LISTER in England, investigated the internal structure of some molluscs. POLI and CUVIER made this subject a primary object of their numerous inquiries, and thus, in the course of the last fifty years, and even in our own day, through the labours of DELLE CHIAJE, OWEN and others, a clear and extensive view has been obtained of a field of comparative anatomy that previously was almost unknown. This was an inestimable gain for a science which, if it is indeed to exercise an important influence on physiology, must not, in any sense, be limited to a few classes of animals, but must, in reality, be *comparing*, and must *compare generally*.

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[1] Compare CHEMNITZ *Vom Ursprunge der Perlen, Naturforscher*, XXV. Halle, 1791, s. 122—130, and BECKMANN'S *Geschichte der Erfindungen*, cited there. On the origin of pearls from eggs of Conchifers see *Phil. Trans.* 1674, Vol. IX. pp. 11, 12, and especially E. HOME in *Phil. Transact. for the Year* 1826, Part 3, pp. 338—341. This peculiarity had already been observed in 1673 by a Dane, H. ARNOLDI, at Christiana in Norway.

[2] See his *Vermium terrestrium et fluviatilium Historia*, Hauniæ, 1774, 4to. Tom. II. Præfat. p. 1.

Some molluscs have no head distinct from the body. Here the principal mass of the nervous system is not placed near to or above the mouth, but if nervous ganglia be found in this situation, they are inferior in development and size to other nervous ganglia; no nerves for special organs of sense arise from the nervous mass situated above the œsophagus. The mouth conducts immediately into the œsophagus, and has no teeth or tongue. These are named *headless molluscs* (*Acephala*). The other molluscs have a head more or less clearly distinct. The *head-bearing molluscs* (*Cephalophora* or *mollusca encephala*) are more perfectly organised, and amongst them alone are species found which live on land; most of the species, however, reside in the water, like the acephalous molluscs. These last may be arranged in two classes, the *naked* and the *bivalve* acephalous molluscs.

# CLASS XI.

## TUNICATES (*TUNICATA*)[1].

THE Tunicates are acephalous molluscs without shells. The external covering is perforated by two openings, in other respects like a sac and entirely closed, of various thickness and hardness, in some gelatinous, in others leathery. It consists of a tissue that is sometimes very composite, includes cells, fibres, nuclei, crystals also of carbonate of lime, and of which the fundamental matter contains no nitrogen, but only oxygen and hydrogen, and agrees in composition with the vegetable cell-membrane (*cellulose*), as was first discovered by C. SCHMIDT in *Ascidia mammilaris*[2].

The intestinal canal forms in most of the *Salpæ* some convolutions, which are united to form a clue which occupies a small part alone of the cavity of the body, and to which FORSKÅL in his descriptions gave the unmeaning name of *Nucleus*. In *Salpa pennata* s. *cristata* CUV., however, the intestinal canal runs straight from the mouth to the opposite end, and has, close above and behind the mouth, an expansion or stomach that terminates blindly and lies in the opposite direction. The mouth, placed internally and bordered by a tortuous band, is properly only the beginning of the œsophagus. A furrow in the middle of the body runs from the opening of the common integument, by which the water is introduced, to this commencement of the œsophagus, and serves probably to conduct towards it the food that is conveyed with the water. [Above this furrow or semicanal, in the substance of the inner mantle is an organ, called by HUXLEY *endostyle*, a long tubular filament with thick refracting walls. It is of various length, very short in

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[1] Compare on this class:

CUVIER *Mémoire sur les Thalides et les Biphores, Ann. du Muséum*, IV. 1804, pp. 360—382, Pl. 68 (*Mémoires sur les Mollusques*, No. 19); *Mémoire sur les Ascidies et leur Anatomie, Mém. du Muséum*, II. 1815, pp. 10—39, Pl. I.—III. (*Mém. sur les Mollusques*, No. 20.)

J. C. SAVIGNY *Mémoires sur les Animaux sans vertèbres*, II. premier fascicule, Paris, 1816, 8vo.

[2] *Zur vergleichenden Physiologie der wirbellosen Thiere*, 1845, s. 62—65. Extensive microscopic investigations respecting the structure of the external covering in many *tunicata*, illustrated by beautiful figures, have been published by LOEWIG and KOELLIKER, *Ann. des Sc. natur.* 3ième Série, v. 1846, pp. 193—238.

*Doliolum*, extending in some *Salpæ* as far as the œsophageal aperture. The tube is closed posteriorly, but, according to LEUCKART, communicates anteriorly with the longitudinal semicanal. Its walls are composed of large nucleated cells, arranged perpendicular to its cavity, and LEUCKART suggests that it may perform a secreting function. HUXLEY has seen it in *Salpæ*, *Pyrosomata* and certain *Botryllidæ*, as well as in *Cynthia*, and, as it seems to be figured by SAVIGNY and others, it may perhaps be concluded to be common to the *Tunicata*[1].]

In the *Ascidiæ* the intestinal canal usually forms two bends, which lie toward each other, and have their convexity facing backwards. The intestinal canal commences at the bottom of the branchial cavity, and becomes narrower posteriorly. The stomach is sometimes merely indicated by a first expansion of the intestine, which is not sharply defined; in other cases its form is elongate and cylindrical, as in *Didemnum* and *Botryllus*[2]. The extremity of the intestinal canal mounts higher than the commencement of the œsophagus, in the direction of the second tubular opening of the external integument of the body. The liver lies as a stratum of glands on the walls of the stomach or the intestinal canal. Salivary glands have as little been met with here as in the bivalve molluscs.

The blood-circulation of the *tunicata* presents the remarkable phenomenon, that the direction in which the blood streams from the heart is at intervals altogether reversed, so that the heart alternately drives the blood to the branchiæ, and may be called venous, and alternately receives the blood from the branchiæ and, as in the rest of the invertebrates, is arterial. This peculiarity was first discovered in 1821 by VAN HASSELT in *Salpa*[3], but was afterwards observed by LISTER, MILNE EDWARDS, VAN BENEDEN and others,

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[1] [See HUXLEY *Phil. Trans.* 1851, p. 588.]

[2] See SAVIGNY *Mém.* II. Pl. XX. XXI. On the intestinal canal of *Ascidia* compare CUVIER *Ascidies*, Pl. 1, fig. 5; *Catalogue of the Physiol. Series of Comp. Anat. of the Museum of the Royal College of Surg.* I. Pl. 5, fig. 1, *Phallusia nigra* SAV., and VAN BENEDEN *Recherches sur l'Embryogenie, l'Anatomie et la Physiologie des Ascidies simples, Mém. de l'Acad. royale de Belgique*, Tome XX. 1846, Pl. 1. fig. 6.

[3] *Alg. Konst-en Letterbode* 1822, I. bl. 115, 116 (translated in *Ann. des Sc. nat.* III. pp. 78—81). Afterward MEYEN in his Voyage observed this motion of the blood in two opposite directions in *Salpa* also; *Act. Acad. Cæs. Leop. Carol.* XVI. I. p. 377. With this in some degree may be compared, what was observed by J. MUELLER (MECKEL'S *Archiv*, 1828, s. 22—29) in *Nephelis* respecting the inconstancy of direction in the blood-current, and by E. H. WEBER (ibid. pp. 399, 400) in young leeches.

in different species of simple and compound *Ascidiæ*, so that it may be safely concluded to be a common property of the animals of this class. The heart has an elongate form and does not exhibit any sudden expansion and contraction, but a sinuously progressive constricting and widening, which is similar in form to the peristaltic motion of the intestinal canal. Besides larger vessels the blood moves in interspaces which have no proper walls.

The respiratory organs are gills which are very different from those of the bivalve molluscs. In the genus *Salpa* the gill is extended as a longitudinal band running obliquely in the inner cavity of the tubular body, with many transverse grooves closely arranged side by side. In the *Ascidiæ* the respiratory organ forms a sac at the bottom of which the entrance to the œsophagus is situated. The very thin membrane, of which the sac consists, presents transverse and longitudinal stripes that cross each other at right angles like trellis-work, to which a net-work of blood-vessels corresponds. The gills, as well of the *Salpæ* as of the *Ascidiæ*, are beset with vibratile cilia[1].

Male and female organs are, at least in the *Ascidiæ*, united in the same individual. Often they are intimately connected with each other and are only to be distinguished by microscopic examination of their content. Some *Ascidiæ*, as *Ascidia ampullaris* V. Bened., have quite a double apparatus of sexual organs, which lies behind in the intestinal sac on each side of the intestinal canal. In some the oviduct is wanting, in others no *vas deferens* exists; a single, long, tortuous canal, which is present in the compound *Ascidiæ*, and is generally held to be the oviduct, ought, according to Milne Edwards, to be regarded as the *vas deferens*. In the *Ascidiæ*, besides the usual propagation by impregnated eggs, a multiplication by buds has also been detected[2].

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[1] Milne Edwards and before him Lister admit openings like fissures between the quadrangular meshes by which the water is expelled from the branchial sac (Milne Edwards *Observ. s. l. Asc. comp.* pp. 17—20). It is difficult to determine, in specimens preserved in spirit, whether they are really openings or spaces closed by a transparent membrane. [Huxley says that in *Pyrosoma* the respiratory cavity communicates freely by means of apertures in the branchial network with the post-branchial or anal cavity. *Phil. Trans.* 1851, p. 581.]

[2] Compare for some other peculiarities, the notice of the different genera in the systematic arrangement, in which also the remarkable propagation of the *Salpæ* is noticed.

The nervous system presents a single ganglion, which in the *Ascidiæ* is placed on the internal covering of the body, usually regarded as the mantle, between the two tubes into which the body is elongated. Besides other nerves which radiate from this ganglion, there appears to arise from it a nervous ring that surrounds the tube by which the water penetrates (the oral and respiratory tube). Other ganglia which are noticed in Ascidians by some writers, are at the least to be regarded as doubtful[1]. In *Salpa* a ganglion (or a nerve-mass formed of several ganglia united) lies close behind the anterior, broader opening on that surface of the body which is directed upwards[2]. Several nerves run radiately from this nerve-mass.

Vestiges of organs of sense are not entirely absent. In the *Ascidiæ* at the branchial aperture a circlet of small filiform feelers, sometimes digitally incised or pennated, is found. In the *Salpæ* there lies in front of the central mass of the nervous system an organ of an elongated form, consisting of two laminæ with an internal margin smooth and an external striated, which ESCHRICHT regards as an organ of feeling and compares with the four lamellæ which surround the mouth in bivalve molluscs[3]. Organs of sight also have been observed in the *Ascidiæ*. There are found both around the branchial aperture of the mantle and around the aperture towards which the extremity of the intestinal canal proceeds, a ring of eye-points, often of a yellow colour[4]. [In *Salpæ* a vesicle

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[1] Thus SCHALK, whose *Dissert. de Ascidiarum Structura* I am acquainted with from citations alone, records a nerve-ganglion in the posterior part of the body, between the convolutions of the intestine; GRANT speaks even of three ganglia, *Outlines of Comp. Anat.* 1811, pp. 205, 206. Compare on the nervous system of the *Ascidiæ*, CUVIER *Sur les Ascidies*, p. 15, Pl. II. fig. 2, c, fig. 5, *g*. SAVIGNY *Mém.* 2, pp. 117, 118, Pl. X. fig. 2, 1 D, &c.

[2] This position of the central portion of the nervous system caused ESCHRICHT to give to the surface the name of ventral side. See on the nervous system of *Salpa* MEYEN l. l. s. 395, and the fig., ESCHRICHT *Anat. physiol. Undersögelse over Salperne.* Kjöbenhavn, 1840, 4to, printed from the *Vidensk. Selsk. Naturvid. og math. Skr.* VIII. pp. 12—14, Tab. I, fig. 3 *u*, Tab. II. fig. 8 *u*, fig. 12; MILNE EDWARDS in CUVIER *R. Ani., éd. ill., Mollusq.* Pl. 120, fig. 1 *b*, *a*, Pl. 121, fig. 2 *a*, *h*, fig. 2 *b*.

[3] [HUXLEY *Anat. of Salpa and Pyrosoma*, Ph. Trans. 1851, p. 571, calls this "*längliches organ*" of ESCHRICHT "*languet.*" He supposes that it may subserve the gustatory function. It floats freely in the respiratory cavity to which it is attached by its base.]

[4] GRANT *Outlines*, p. 361, says that in *Ascidia* (*Phallusia*) *intestinalis* eight red eye-points lie round the branchial opening, and six around the efferent tube; so also, according to the investigations of WILL in various species of *Cynthia* SAV. and *Clave-*

attached to the lower surface of the nerve-mass and containing calcareous bodies would seem to represent the auditory capsule and its otolithes[1].] Such an organ also, but containing a concrement of a more composite form, was discovered by ESCHRICHT, similarly situated in a simple Ascidian *Chelyosoma Macleayanum*, and noted as the auditory organ[2] in 1841.

The muscular system in *Ascidiæ* consists of a layer of fibres, which cross each other on the inner covering of the body (the so-called mantle), but run principally in a longitudinal direction. In the *Salpæ* muscular bands are seen remote from each other, which, like a girdle not entirely closed at one part, surround the internal cavity of the body, the respiratory space. These bands consist of fibres that run parallel to each other in the direction of the bands, and thus form a right angle with the longitudinal axis of the body.

On the position of these animals in the natural system there can exist no doubt when they are referred to the common type of the molluscs. They must be regarded as the lowest division of these animals, that immediately close in upon the bivalves. The compound Ascidians in propagating by gems remind us of lower animals of the class of the Polyps. More especially still do the Ascidians resemble the *Bryozoa* (comp. I. pp. 92, 93), but we should prefer to unite these last with the *Mollusca*, rather than on account of this affinity to separate the *Tunicata* from the *Mollusca*.

Species of this class are met with in all seas. The *Salpæ* are numerous in the Mediterranean and in the ocean, especially between 30° and 40° N. and S. Lat., in colder regions and in higher latitudes they are of more rare occurrence although they extend to 50° N. and S. Lat., and were once observed near the Norwegian coast even

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*lina*. V. BENEDEN in a species of *Ascidia* named by him *Ascidia vitrea*, found eight eyes at both openings; *Rech. s. l. Ascid. simples*, p. 61, Pl. IV. fig. 2. In *Ascid. ampulloides* V. BEN. such eye-points cannot be seen, but when young and still moving freely the animal has one or two black eye-points; ibid. p. 40.

[1] [HUXLEY l. l. p. 571, Pl. XVI. fig. 2.]

[2] ESCHRICHT *Anatomisk Beskrivelske af Chelyosoma Macleayanum* of SOWERBY, Kjöbenhavn, 1841, quoted by SIEBOLD *Vergl. Anat.* I. p. 260 (note), who suspects from the figures of DELLE CHIAJE and SAVIGNY that the organ exists very generally in this class. MILNE EDWARDS (see the figures of *Salpa* referred to above in the illustrated edition of CUVIER) thinks that it must be regarded as an organ of vision. That MEYEN had observed this organ lying above the central nerve-mass, I collect from his figure, Tab. XXVII. fig. 18.

in 62° N. Lat.[1] They appear on the coasts, however, only rarely, but keep by preference in the open sea, far from the continent. Ascidians, as well compound as simple, occur in much higher latitudes; *Boltenia ovifera* was discovered in Davis's Straits at 69° N. L., *Synoicum turgens* in Phipps's voyage at the north coast of Spitzbergen. Species of all the forms, nay, even of most of the sub-genera, are found in the Mediterranean sea; the apparent preponderance in number of species in this sea, above all others, may however be principally ascribed perhaps to this, that its productions have been more perseveringly investigated by numerous observers, than those of the other seas.

[1] In the autumn of 1839 in great numbers near the island *Bremanger;* SARS *Fauna littoralis Norvegiæ.* Christiana, 1846, folio, p. 63.

# SYSTEMATIC

# ARRANGEMENT OF TUNICATES.

## CLASS XI.

### TUNICATA.

ANIMALS without distinct head, inclosed in an external covering coriaceous or membranous, and furnished with two apertures. A second tunic included in the former, perforated by two orifices corresponding to the apertures of the external covering. Cibarious canal with mouth and anus internal, concealed. Respiration branchial, branchiæ situated internally in front of the internal mouth or the commencement of the œsophagus, of different form in different cases, never divided into four laminæ. Heart tubular, propelling the blood in a mutable direction.

#### ORDER I. *Thaliacea.*

Body prismatico-cylindrical, with two apertures opposite, subterminal. Covering pellucid, thin, rigid. Animals swimming freely, drawing in the water by one aperture, expelling it by the other.

Family I. *Salpina.* (Characters of the order those also of the single family.)

*Salpa* FORSK., GMEL., CUV., LAM., species of *Holothuria* L. (*Thalia* BROWN, BLUMENBACH, *Dagysa* BANKS and SOLAND., GMEL., HOME). Branchiæ extended obliquely through the internal cavity of body. Form in each species two-fold, the solitary progeny alternating with the associated.

Comp. P. FORSKÅL *Descriptiones animalium.* Hauniæ, 1775, pp. 112—117; ejusd. *Icon. Rer. natur.* ibid. 1776, Tab. 35, 36; CUV. *Mém.* (v. supra p. 691); A. DE CHAMISSO *De Animalibus quibusdam e Classe vermium. Fasciculus* I. *De Salpa.* Berolini, 1819, 4to; MEYEN l. l.; ESCHRICHT l. l.; KROHN *Observations sur la génération et le développement des Biphores,*

*Ann. des Sc. nat., 3ième Série,* VI. 1846, *Zoologie,* pp. 110—131. HUXLEY *Observations upon the Anatomy and Physiology of Salpa and Pyrosoma.* Phil. Trans. 1851, Pt. II. p. 567.

The species of *Salpæ* are very generally dispersed; sometimes they are met with in incredible quantities together; notwithstanding, these animals a century ago were entirely unknown. The first announcement of them was made by P. BROWN in his *Civil and Natural History of Jamaica,* published in 1756, under the name of *Thalia;* afterwards followed the description of the species observed in the Mediterranean and Red Sea, under that of *Salpa* by the Danish traveller FORSKÅL[1]. BOSC and CUVIER next pointed out the resemblance of these animal species, described under two different names, which ought to be referred to the self-same genus.

The body has an aperture at each extremity, but these apertures have a different form. The one is broad and transverse, and presents a valvular membrane, inasmuch as one of its margins is reflected inwards. The valvular membrane prevents the efflux of the water, which flows inwards by this opening and which is expelled by the opposite one from the contraction of the body. This expulsion of the water is the means by which the animal moves, so that the narrower opening is turned backwards. CUVIER thought that this opening was the anterior, and that thus the animal moved backwards. Since, however, the stream of water conducts also the food, and since in the *Ascidiæ* the entrance to the œsophagus is situated behind in the respiratory sac, the common opinion, that the broad opening is the anterior, deserves to be preferred to this idea. The intestinal canal is situated on the outside of the respiratory cavity, in the space intervening between the external and internal covering, but terminates by both its apertures in the respiratory cavity.

These animals, according to the testimony of PÉRON, TILESIUS, MEYEN and others, are usually phosphorescent by night. The *Salpæ* are met with at one time singly, as distinct individuals, at another, united either in rings or in long chains, of which the arrangement is various, yet similar in individuals of one and the same species. These are attached to each other by tubercles or prolongations. CHAMISSO, from his observations on living animals, arrived at the conclusion, that successively a generation of distinct *Salpæ* alternates with that of *Salpæ* connected, and forming a chain. Thus a metamorphosis occurs, which, however, does not take place

[1] BRUGUIÈRE, who gave in the *Encycl. méthod.* an extract from the descriptions of FORSK., changed the name *Salpa* into *Biphora,* which has found no general acceptance.

in the same individual, but in two succeeding generations. The parent animal, for instance, always resembles her grand-daughter and her sister, not her daughter, which, again, resembles the preceding generation. This conclusion seemed to most succeeding observers so strange, that they thought it could not be adopted; MEYEN supposed that these animals are always born as single individuals, and only become united subsequently. Nevertheless, ESCHRICHT discovered within single individuals embryos connected together in a wreath, so that hereby CHAMISSO's conclusion was established, that chains of connected *Salpæ* were formed even within the parent. STEENSTRUP brought this peculiarity in the propagation of the *Salpæ* into unison with other phenomena in the animal kingdom, in his interesting work, *Om Fortplantning og Udvikling gjenem Generationsrackker*, (see above, p. 70), and the meritorious Norwegian observer SARS, completely confirmed it (*Faun. littor. Norvegiæ*). With it too the numerous observations lately communicated by KROHN, are in accordance. The solitary *Salpæ* are sexless, and are propagated by internal germs or buds connected in strings. Hence the associated form appears to be the most perfect, that in which organs of propagation are developed, (and organs of impregnation also, *testes*); each individual of the associated *Salpæ* produces only a single young one.

Sp. *Salpa maxima* FORSK. *Icon.* Tab. XXXV. fig. A, MILNE EDWARDS, CUV. *R. Ani., éd. ill., Moll.* Pl. 120, 121, fig. 1 (here belongs, according to KROHN, *Salpa Forskalii* LESSON and the solitary form *Salpa africana* FORSK.);—*S. runcinata* CHAMISSO l. l. fig. V. *Salpa fusiformis* CUV. *Mém. s. l. Biphores*, fig. 10, SARS l. l. Tab. VIII. figs. 44, 45, Tab. IX.;—*Salpa pinnata* FORSK., *S. cristata* CUV., FORSK. *Icon.* Tab. cit. fig. B, CUV. *Mém.* figs. 1—3, 11, CHAMISSO l. l. fig. 1 (associated form arranged in a circle) &c.

*Note.*—The species of *Salpæ* are not yet sufficiently known, of many at least, the synonymy is very difficult, full of doubt. KROHN l. l. has endeavoured to unravel the species from the Mediterranean. To the authors already cited, the French voyagers QUOY and GAIMARD *Voyage de l'Astrolabe, Zoologie*, Tom. III. 1835, pp. 559—598, Pl. 86—89, are to be added.

*Anchinia* ESCHSCH., RATHKE. Small *Salpæ* aggregated in a single row to a gelatinous filament. See WIEGMANN'S *Archiv*, 1835, I. p. 85.

*Doliolum* QUOY and GAIM. [Body cask-shaped. Branchiæ in two bands with perpendicular bars, one on the dorsal (*hæmal*) the other on the ventral (*neural*) surface of the respiratory cavity, converging and passing into each other posteriorly.]

*Doliolum* OTTO differs from that bearing the same name: whether it be a *Beroë* or a mutilated *Salpa*, I know not. Comp. *Nov. Act. Acad. Leop. Car.* XI. Tab. 42, fig. 4.

[Sp. *Doliolum denticulatum* QUOY and GAIM. The openings of the branchial cavity are short tubes, the anterior denticulate, the posterior surrounded by fine filaments. S. Pacific. If it be ever aggregated, it has not been met with in this state. HUXLEY *On Doliolum and Appendicularia, Phil. Trans.* 1852, pp. 599, 603.]

[*Appendicularia* CHAMISSO, QUOY and GAIM. (*Oikopleura* MERTENS). Body irregularly ovate, with a long appendage attached to the dorsal surface at the posterior part, and making a large angle with the axis of body. Opening into the respiratory cavity anterior, outlets two short tubes ciliated where they leave the cavity, opening immediately on the dorsal surface in front of the base of appendage[1]. No proper branchiæ.

There has been much doubt respecting the place and the nature of *Appendicularia*. CHAMISSO, who found his species in the N. Pacific, considered it to be a *Medusa* allied to genus *Cestum*. ESCHSCHOLTZ, who observed the same, or a nearly allied species, in the South Sea, referred it to the Heteropod Molluscs, whilst MERTENS, who voyaged in the same seas, thought it was a Pteropod related to *Clio*. See CHAMISSO *Nov. Act. Acad. Cæs. Leopol. Car.* X. Pt. 2, p. 362, ESCHSCHOLTZ in OKEN'S *Isis*, 1825, s. 736, MERTENS *Mém. de l'Acad. imp. de St. Petersbourg*, 1831, Tom. I. p. 205. LEUCKART (*Zoolog. Untersuch.* II. 1854, pp. 80, 81) regards *Appendicularia* as a larval state of some Ascidian, all of which have an appendage in the early condition, whilst with HUXLEY (*On Appendicularia and Doliolum, Phil. Trans.* 1851, p. 595) and GEGENBAUER (SIEBOLD and KOLLIKER'S *Zeitsch. f. wissensch. Zool.* B. VI. 1855, p. 406, &c.) it is an adult form.

Sp. *Appendicularia flabellum* CHAMISSO, see HUXLEY l. cit., who found the testis in the fully developed condition abounding with *spermatozoa:* the ovary has not been ascertained; coast of Scotland, and common in the Bristol Channel near Tenby. For a description of four Mediterranean species, with the anatomy, see GEGENBAUER loc. cit.]

*Anchinia* ESCHSCH., RATHKE. Small *Salpæ* aggregated in a single row by a gelatinous filament. See WIEGMANN'S *Archiv*, 1835, I. p. 58.

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[1] [These tubes were first discovered by GEGENBAUER, but from the great transparency, he did not detect their openings on the surface of the animals, but supposed them to conduct the fluid from the respiratory cavity, in order either to mix it directly with the blood, or by expanding more largely to bring it in near contact with the blood through their thin walls. See his paper, pp. 415, 416. HUXLEY, as well by direct observation as by feeding his animals on indigo, saw clearly the external apertures of the tubes in front, and on each side of the anus. In one observation he found the current to set *in* at these apertures, and *out* at the anterior opening of the respiratory sac. See his paper on *Appendicularia flabellum, Quarterly Journal of Micros. Sc.* No. 15, 1856, pp. 181—191.]

## Order II. *Tethyonidea.*

Body sacciform, with two apertures mostly approximate. Covering coriaceous or gelatinous, mostly opaque. Branchial sac large, reticulato-fenestrate, with rectangular areolæ; the beginning of œsophagus situated at the bottom of this sac. Animals mostly affixed. Propagation oviparous and gemmiparous.

To this order some compound animals belong which were formerly referred, for the most part, to the *Alcyonidia* (see above, p. 78). The discovery of their true affinity is one of the most interesting results of the accurate investigations of Savigny. Compare on this order the above-cited works of this author, as well as those of Milne Edwards, Van Beneden, &c.

Besides the two divisions of *Ascidiæ* into simple and compound, Milne Edwards has adopted a third, that of the *social Ascidiæ*, which are distinguished by forming gems, without being grown together like the compound *Ascidians*. This gemmation has, however, been noticed in a species ordinarily simple[1], and may perhaps occur in all the animals of this division.

Young *Ascidians*, which do not originate in gemmation but proceed from eggs, undergo an interesting metamorphosis. In the early stage they move freely, and are provided with a long tail, as was communicated by Milne Edwards (*Ann. des Sc. nat.* xv. p. 10), as early as 1828, and was afterwards more fully described by V. Beneden and others. They fix themselves by that extremity which is opposite to the tail, which they then lose[2]. In compound *Ascidians*, according to the observations of Sars on *Botryllus*, such a cercariæ-form larva may already enclose a group (eight) of united *Ascidians*. Thus, even before the *Ascidia* has become attached, by the division of the gem the commencement is made of a colony which is capable of further multiplication by the formation of gems. Not, however, in all compound *Ascidians* is this original

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[1] According to Bohadsch in *Ascidia intestinalis* (*Phallusia intestinalis* Sav.). See J. B. Bohadsch *De quibusdam Animalibus marinis*. Dresdæ, 1761, 4to, pp. 132—135, Tab. x. fig. 5.

[2] As to the question, which is the anterior and which the posterior extremity of these Cercariæ-form larvæ, consult R. Leuckart *Ueber Morphologie und die Verwandtschaftsverhältnisse der Wirbellosen Thiere*. Braunschweig, 1848, 8vo, s. 173, 174.

connexion to be detected, not at least, according to MILNE EDWARDS, in *Polyclinum*.

Family II. *Luciæ*. Apertures of external covering opposite, terminal. Branchial sac girdled anteriorly by a membranous denticulate ring, open posteriorly. Several animals aggregated to form a compound body swimming freely, cylindrico-conical, hollow internally.

*Pyrosoma* PÉRON.

This genus of compound *Ascidiæ* was first discovered by PÉRON and his fellow-voyagers in the Atlantic ocean under the Tropics, when in a dark night numerous specimens of it appeared to form a broad band of light across the sea. From this phosphoric quality, the name (*Fire-body*) is derived. At first these compound animals were supposed to be a single animal, and the single individuals of which a *Pyrosoma* is compounded, to be little tubercles on the surface of the animal. See PÉRON *Mém. sur le nouveau genre Pyrosoma, Ann. du Muséum*, IV. pp. 437—446. For a more accurate knowledge of this remarkable genus we are indebted almost exclusively to the investigations of SAVIGNY. The compound body is a much-elongated cone, ordinarily six or seven inches in length, open at one end and at the other closed and bluntly rounded off. The little animals are placed perpendicularly to the axis of the cone, in circles more or less irregular, whilst the posterior openings of their body terminate in the cavity of the cone. The gem, according to the observations of SAVIGNY, is already cloven into four animals even before they are born. This is the commencement of the cylinder or cone, which may be imagined to be formed of a series of circles or girdles of small *Ascidiæ* behind each other of increasing size; the thinner closed extremity of the compound body is thus the first formed. Consult SAVIGNY l. cit. pp. 58, 206.

Sp. *Pyrosoma atlanticum* PÉRON, l. l. Pl. 72, *Voyage aux Terres Australes*, Pl. 30, fig. 1;—*Pyrosoma giganteum* LESUEUR, SAVIGNY *Mém.* II. Pl. 4, fig. 7, Pl. 22, 23, BLAINV. *Malac.* Pl. 83, fig. 6, CUV. *R. Ani., éd. ill., Moll.* Pl. 133; in the Mediterranean: there is still a smaller species in the same sea in which the individual animals are placed in regular circles round the cone; *Pyros. elegans* LESUEUR.

Family III. *Ascidiæ*. Apertures of external covering not opposite, mostly approximate. Branchial sac closed posteriorly. Animals either single, or congregated into a common body, affixed.

A. Compound Ascidians. Common body gelatinous, or gelatinoso-coriaceous, polymorphous, often expanded, incrusting the surface to which it adheres.

*Botryllus* GÆRTNER. Body of the animalcules not distinguished into thorax and abdomen; branchial aperture circular without rays. Several clusters of animals, each of them mostly stellate.

Sp. *Botryllus Schlosseri* SAV., *Alcyonium Schlosseri* L., *Botryllus stellatus* GÆRTN., PALL. *Spic. Zool.* x. Tab. IV. figs. 1—5, SAVIGNY l. l. Tab. XX. fig. 5;—*Botryllus polycyclus* SAVIGNY l. l. Tab. IV. fig. 5, Tab. XXI. (repeated in GUÉRIN *Iconogr., Mollusq.* Pl. 35, fig. 1). In this and other species every group has a common central cavity, into which the posterior aperture of each several animalcule opens. In other species the several animalcules are not placed circularly round such a cavity, and the two openings of the body are closer together. The common mass is penetrated by canals. Here belong the species which SAVIGNY refers to his first division of *Botryllus;* MILNE EDWARDS forms of them, with the addition of some new species first described by him, a separate genus under the name of *Botrylloïdes.*

*Didemnum* SAV. (and *Eucœlium* ejusd.) Common body sessile, incrusting, without central cavity. Animalcules divided into two separate parts, with branchial sac separated like a thorax from the abdomen. Anal orifice without rays. Many groups of animals collected in a common body.

*a.* Branchial orifice rotundate, destitute of rays.

*Eucœlium* SAV.

*b.* Branchial orifice with six equal rays or lobes.

*Didemnum* SAV., *Didemnum* and *Leptoclinum* MILNE EDW.

Sp. *Didemnum candidum* SAV. l. l. Pl. IV. fig. 3, Pl. XX. fig. 1, CUV. *R. Ani., Moll.* Pl. 129, fig. 3, &c.

*Polyclinum* SAV. (and *Aplidium* ejusd.) Common body sessile, polymorphous, often incrusting. Many groups of animalcules collected together in a common body. Animalcules divided into three separate parts, with ovary and heart behind abdomen contained in the last part. Branchial orifice sexradiate; anal orifice without rays.

Sp. *Polyclinum constellatum* SAV. l. l. Pl. IV. fig. 2, Pl. XVIII. fig. 1, GUÉRIN *Iconogr., Moll.* Pl. 35, fig. 4; on the coasts of the island Mauritius;—*Aplidium ficus* SAV., *Alcyonium ficus* L., ELLIS *Corallines,* Pl. XVII. fig. *b.* B, &c.

*Note.*—Here also is to be referred sub-genus *Amàroucium* EDW. (better, perhaps, *Amareucium* from ἀμάρεύω, on account of the channelled canals that permeate the common body like *cloacæ* or sewers). Sp. *Amar. proliferum* MILNE EDW. *Observat. s. l. Asc. comp.* Pl. 1. fig. 3, *Amar. aureum* MILNE EDW., CUV. *R. Ani., éd. ilt., Moll.* Pl. 130, fig. 1, *Paraseidia* MILNE EDW., a new genus different from all its congeners by the octoradiate branchial orifice: *R. Ani.* ibid. fig. 3.

*Distomus* GÆRTN., *Distoma* SAV. (a name to be rejected as previously ascribed to a genus of *Entozoa*). Common body sessile, coriaceous, polymorphous. Several groups of animalcules. Animalcules divided into three separate parts. Six radii in the branchial and in the anal orifice.

Sp. *Distomus variolosus* GÆRTNER, PALL. *Spicil. Zoolog.* Fasc. X. Tab. IV. fig. 7 *a.* A, &c.

*Sigillina* SAV.

*Synoicum* PHIPPS, SAV. Common body erect, cylindrical, coriaceous, adhering by the base. Animalcules divided into three parts, elongate, arranged in a circular group at the incrassated apex of the common body. Branchial orifice with six equal rays, anal aperture with unequal rays, three larger and three small, subindistinct.

Sp. *Synoicum turgens* PHIPPS, *Voyage towards the North Pole in* 1773, London, 1774, 4to, pp. 199, 200, Pl. XIII. fig. 3, SAV. *Mém.* l. l. Pl. III. fig. 3, Pl. XV.

*Diazona* SAV. Common body gelatinous, sessile, orbicular, excavated in the middle. Animalcules divided into three separate parts, arranged in several concentric series. Six equal rays at the orifice of the branchial and of the anal aperture.

Sp. *Diazona violacea* SAV., *Polyclinum diazona* CUV. *R. Ani.*, éd. 1, Tab. XI. fig. 6, éd. 2, Tab. XIV. fig. 6, SAVIGNY l. l. Pl. II. fig. 3, Pl. XII. The entire system resembles a compound flower or an Actinia, and attains a diameter of six inches; the colour is a handsome violet. This species has been found in the Mediterranean on the Spanish coast.

B. Simple Ascidians, solitary or associated by gemmiferous stolons. External integument sacciform, coriaceous or gelatinous, with two apertures approximate. (Genus *Ascidia* L.)

The non-pedunculated sacciform species have been long known, and were well described by ARISTOTLE under the name of τήθυον. *De Anim. Hist.* IV. Cap. 6. LINNÆUS at first named this genus *Tethys*, but confounded with it different animals which alone now keep this generic name. BASTER on that account gave to this genus

the name of *Ascidium* (*Natuurk. Uitspanningen*, I. bl. 97), and LINNÆUS, in the twelfth edition of his *Systema Naturæ*, changed this name, without any reason that I am aware of, into *Ascidia*.

These *Ascidiæ* or *bag-pipes* (*zakpijpen*), as BASTER names them, are always attached to other bodies, to rocks, shells, crabs, &c. Often several individuals are united in a single group; they never, however, form such a compound body as the preceding genera, which are distinguished by the *orificia analia* being always turned towards each other, and more or less really united, (SAVIGNY, *op. cit.* p. 120), whilst the external covering is common to all the individuals that combine to form the group.

These animals ingurge water through the branchial aperture, and eject it chiefly by the same aperture in jets, which may serve as a defensive means for chasing animals away that attack them. CUVIER asserts that the expulsion of water can be performed through the branchial aperture alone. Those writers, however, who have observed them alive, are unanimous in their testimony that the ejection of water is effected through both apertures. CARUS tells, that in a large specimen of *Ascidia microcosmus* he saw an opening furnished with a membranous valve, which appeared to lead from the branchial sac to the *porus analis*. Other writers, however, do not speak of such an opening. On the supposition of LISTER and MILNE EDWARDS that the branchial sac is perforated like a sieve (see above, p. 693), the matter may be explained without difficulty. Whether *Ascidians* also ingurge water by the cloacal aperture after a vacuum in the gill-sac has been caused by contraction, as SAVIGNY suspected (*op. cit.* p. 100), deserves further investigation.

*Ascidians* live on small organic particles, which are brought with the water into the respiratory sac and thence to the œsophagus that opens at its bottom. Sometimes, indeed, small crustaceans have been found in the sac, but they would seem to have arrived there fortuitously; for when they have been ingurged by an *Ascidian* they are rather hurtful than beneficial, and in some cases even injure the tissue of the gills.

EYSENHARDT has published observations from which it appears that the body of Ascidians in a singular manner may change into a formless mass, on which other Ascidians attach themselves, and take root. *Nov. Act. Acad. Cæs. Leop. Carol.* Vol. XI. 1823, pp. 249—272.

Comp. also on these animals (besides the works of CUVIER, SAVIGNY and VAN BENEDEN already cited) CARUS *Beiträge zur Anatomie und Physiologie der Seescheiden*, in MECKEL'S *Arch. f. die Physiol.* II. 1816, s. 569—590

(the figures relating to this memoir were also given, better executed, in Pt. X. of the *Nov. Act. Acad. Cæs. Leop. Car.* 1821, p. 423);—W. S. Mac Leay *Anatomical Observations on the Tunicata, Linn. Trans.* xiv. 1825, pp. 527—555;—Philippi *Rhopalæa ein neues Genus der einfachen Ascidien*, Mueller's *Archiv*, 1843, pp. 45—57 (which memoir contains some notices on different simple Ascidians found by the author near Naples).

A. *External tunic gelatinous. Two orifices, either without distinct rays, or furnished with more than four rays.*

*Perophora* Wiegm. Body compressed, sacciform, placed by means of a short petiole on a creeping tube, connecting several individuals. Branchial sac ample, produced to the posterior part of body.

Sp. *Perophora Listeri*, a small animalcule living socially, fixed on *Conferva elongata* by a creeping, cirrus-bearing pedicle: found by Lister on the English coast, *Phil. Trans. for* 1834, Pt. 2, pp. 378—382, Pl. xi. In the pedicle, connecting the animal, a double blood-current was observed. The name *Perophora* is given to this genus of *Ascidia* by Wiegmann in his *Report on the Advancement of Zoology in* 1834, *Archiv f. Naturgesch.* 1835, I. s. 309.

*Clavelina* Sav. Branchial and cloacal pore without rays. Branchial sac short, destitute of papillæ, not plicated. Body oblong, attenuate at the base, petiolate.

Sp. *Clavelina borealis* Sav., *Ascidia clavata* Pall., *Spicil. Zool.* x. Tab. i. fig. 16, Sav. l. l. Pl. i. fig. 3, Pl. xi. fig. 2. In the North and Polar seas; *Clavel. lepadiformis* Sav., *Ascidia lepadiformis* O. F. Mueller, *Zool. Dan.* Tab. 79, fig. 5, Milne Edwards *Observ. l'Asc.* Tab. i. fig. 1. Tab. ii. fig. 1, &c.

Sub-genus: *Rhopalæa* Philippi. Branchial pore sexradiate, anal octoradiate. Branchial sac short, beset with papillæ, with transverse striæ subindistinct. Body elongate, clavate, petiolate, with covering pellucid.

Sp. *Rhop. neapolitana* Philippi l. l. Tab. iv.

*Phallusia* Sav. Body sessile, mostly oblong. Branchial pore mostly with eight or nine radii, cloacal pore sexradiate. Branchial sac not plicated, ample, descending to the bottom of internal tunic or reflected at the bottom.

Sp. *Phallusia mammillata, Ascidia mammillata* Cuv. *Mém. s. l. Ascidies.* Pl. iii. *R. Ani., éd. ill., Moll.* Pl. 125, fig. 1; in the Mediterranean. The thick, white, gelatinous, semi-transparent external tunic presents under the microscope large oval vesicular cells, without nuclei; this species attains a size of more than 4 inches, &c.

B. *External tunic coriaceous, hard. Branchial orifice and anal cloven into four rays. Branchial sac plicate.*

*Cynthia* SAV. Body sessile.

Sp. *Cynthia papillata* SAV., *Ascidia papillosa* L., BOHADSCH *de quibusd. Anim. mar.* p. 130. *Tethyon coriaceum*, Tab. X. fig. 1, CUV. *Mém.* Pl. II. figs. 1—3, RANG in GUÉRIN *Mag. de Zool.* 1834, Cl. v. Pl. 43; Mediter.; —*Cynthia microcosmus*, *Ascidia microcosmus* CUV., *Ascidia Cuvierii* PHILIPPI, CUV. l. l. Pl. 1. figs. 1—6; the surface of the hard and wrinkled covering is often beset with sertulariæ, corals and conchifers; this species also is found in the Mediterranean Sea.

Sub-genus: *Dendrodoa* MAC L.

Sp. *Dendrodoa glandaria* MAC LEAY l. l. Tab. 20, p. 547.

*Boltenia* SAV. Body oval, placed on a round petiole.

Sp. *Boltenia fusiformis* SAV., *Vorticella Bolteni* L., *Ascidia clavata* SHAW (not PALL.), J. R. BOLTEN *Epist. ad* C. A. LINNÉ *de novo quodam Zoophytor. genere*, Amstelrod. 1771, 4to. c. Tab. color.;—*Boltenia ovifera* SAV., *Ascidia pedunculata* SHAW, *Vorticella ovifera* L., SAVIGNY l. l. Pl. 1. fig. 1, B, BLAINV. *Malacol.* Pl. 8, fig. 3, &c.

Sub-genus: *Cystingia* MAC L.

Sp. *Cystingia Griffithsii* MAC LEAY l. l. Tab. 19, pp. 540—545, near the North Polar-circle in *Fox-Channel*, met with in PARRY'S expedition. Perhaps it belongs to sub-genus *Boltenia legumen* LESSON, *Centur. zool.* Pl. 5, fig. 1, pp. 149, 150.

C. *External tunic hard, composed of separate scutella. Body sessile.*

*Chelyosoma* SOWERBY. Body depressed, discoidal, adhering to foreign bodies. Orifices conical, both closed by six triangular valves.

Sp. *Chelyosoma Macleayanum, Zoological Journal*, 1829, XVII. p. 46, D. F. ESCHRICHT *Anatomisk Beskrivelse af Chelyos. Macleayanum, Vidensk. Selsk. naturvid. og math. Skr.* IX. 1842, pp. 1—16, Tab. 1.

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NOTE.—It may suffice here simply to name the genera *Pedotethis* and *Syphonotethis*, of which the author, GERVAIS, has given the names alone (*Ascidies, Dict. univ. d'Hist. nat.* II. 1842, pp. 207, 208).

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# CLASS XII.

## CONCHIFERS (*CONCHIFERA*)[1].

WITH LAMARCK we unite all the bivalve molluscs in a single class, which also contains the *Brachiopoda* of CUVIER. They are acephalous molluscs, of which the mantle is always more or less, and often entirely, cloven into two laminæ, and which are covered by a bivalve shell. Their respiratory apparatus is external, and situated either between the mantle and the body in form of plates, or in the substance of the mantle itself.

The intestinal canal, very various in length, is closely surrounded by the other viscera. The œsophagus is short, or there exists no œsophagus obviously distinct. Ordinarily a stomach is present, yet in *Ligula* the intestinal canal is almost of the same width throughout; and in *Orbicula* also a stomachal expansion is not apparent. Salivary glands are not present in the *Lamellibranchiata;* in the *Brachiopoda* it is doubtful whether one of the glandular masses, that surround the intestinal canal, is to be regarded as a salivary gland[2]. Largely developed on the other hand is the liver, which, as in the rest of the invertebrate animals, receives arterial blood alone, and has no gall-bladder. Numerous lobes, consisting either of blind sacs or of branching cœcal tubes,

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[1] Most of the general works on this class treat also of the rest of the molluscs, and have been partly cited above. Here belongs especially the great work of POLI. Compare besides, the article *Conchifera* of DESHAYES in TODD'S *Cyclopœdia of Anatomy and Physiology*, I. 1836, pp. 694—716, and R. GARNER, *On the Anatomy of the lamellibranchiate Conchifera, Trans. of the Zool. Soc.* II. 2, pp. 87—101, Pl. 18—20.

[2] In *Ligula Anatina* CUVIER observed a difference of colour in these glandular masses, which led him to consider the round white gland, situated in the middle, to be salivary, the lateral, divided into many lobes, and yellow brown, to be a liver. OWEN could not perceive such difference of colour in *Lingula Audebardii*, and supposes that, in the specimens examined by CUVIER, it was to be ascribed to some accidental cause, as bleaching by the spirit in which the animals were kept (*Trans. Zool. Soc.* I. p. 157). I must, however, observe that the specimen examined by me gave the same results as CUVIER has noticed, although I do not regard difference in colour as a certain proof of difference in function. In the other genera of *Brachiopoda*, which I have not examined, *Terebratula* and *Orbicula*, OWEN found no glands except the liver.

surround the stomach and intestine, and pour the bile by more than one opening into their cavity. In many *Lamellibranchiata* there is found, either in a blind appendage at the undermost part of the stomach, or in the intestine itself below the stomach, a transparent elongated organ (the crystal style), on that extremity of which that projects freely into the stomach, a small membranous cartilaginous protuberance, divided into three or more irregular processes or points, is seated[1]. The use of this apparatus is not yet rightly understood. POLI thinks the elasticity of the organ may press the points of the protuberance towards and into the openings of the gall-ducts, and thus moderate the influx of bile when not required; but such a regulator is unexampled in the animal kingdom. That the style may effect the recoil of the foot, has been suggested by GARNER, without any accurate explanation of the mode in which this is produced, whilst, at the same time, the free projection into the stomach of the tricuspid protuberance remains unexplained. We confess rather that we do not yet understand the organ, because we can compare it with no other in the rest of the classes of animals.

The circulation of the blood has in this class always a central organ, a heart with a single ventricle, sometimes two hearts remote from each other; for instance, in the *Brachiopoda* and in *Arca* amongst the *Lamellibranchiata*[2]. In this case, however, the two hearts fulfil the same office on each side of the body, and are both arterial like the single heart in the rest of the acephalous molluscs: the blood, namely, flows from the gills to the heart, not from the

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[1] POLI names this protuberance *sagitta tricuspis;* see on this subject his celebrated work *Testac. utr. Sicil.* I. *Introd.* p. 41, and the figures for example, from *Pholas dactylus,* Tab. VII. figs. 9, 10, 11, from *Tellina planata,* Tab. XIV. figs. 9, 10, from *Cardium rusticum,* Tab. XVI. figs. 13, &c. The circumstance that the crystal style is sometimes not to be found, and, as V. SIEBOLD thinks, is developed and disappears periodically (*Lehrb. d. vergl. Anat.* I. s. 263, note 15), indicates an analogy with the *lapides cancrorum* (see above, p. 616) that promises, perhaps, to throw a clearer light upon it.

[2] For the *Brachiopoda* compare CUVIER *Mémoire sur l'Animal de la Lingula, Mémoires sur les Moll.,* and OWEN, *Lettre à* M. MILNE EDWARDS, *Ann. d. Sc. Nat.,* 3ième Série, *Zool.* III. 1845, pp. 315—320, also HUXLEY *Contributions to the Anatomy of the Brachiopoda,* in *Proceedings of the Roy. Soc.* Vol. VII. pp. 106—117, 1854, who throws some doubts upon the office of the so-called hearts; their number, also, he states to be in some cases four. For *Arca* see POLI *Test. utr. Sic.* II. pp. 182, 183, Tab. XXV. fig. 2.

heart to the gills. When a single heart is present, it is usually seated between the two membranous triangular auricles that have their points turned towards the heart. From the heart arise the arteries, which, however, do not pass from capillaries into veins; the arterial blood flows, according to the interesting discovery of MILNE EDWARDS[1], not through closed vessels, but in reticular interspaces (*lacunæ*), which are emptied into larger venous sinuses, [or rather the so-called close vessels expand, their attenuated proper tunic being continued into these lacunæ and sinuses[2]].

The respiratory organs are, in the *Brachiopoda*, situated on the mantle, or the vascular mantle itself serves for respiration. In the *Lamellibranchiata* the gills lie as plates between the margins of the mantle. Ordinarily two gills are present on each side. Each gill consists of two plates, which are more remote from each other on the dorsal surface, and coalescent at their free outer margin. Sometimes the triangular spaces which are thus formed in the gills are capable of a great extension, and serve, as in *Anodonta*, as temporary repositories for the eggs,—brooding cavities. On each plate numerous transverse stripes or projecting lines are seen, along which the currents of blood pass in the gills. In *Arca*, *Pecten*, and *Spondylus*, each of these projecting lines is changed into a free filament, and the gills thus consist here not of plates but of threads, which, though separate, are still from their numbers placed close together[3]. The gills in this condition resemble those of bony fishes, whilst the laminated structure, which in the *Lamellibranchiata* is that generally prevalent, occurs in these fishes (in *Xiphias gladius*) only as the exception. Another deviation from the ordinary type of the gills is seen in some genera of *Lamellibranchiata* in the number of these organs, when on each side, instead of two, only a single gill is present[4]. From the common opinion that the

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[1] *Ann. des Sc. Nat.* 3ième Série, III. 1845, pp. 300—304.

[2] [Vid. OWEN *Introduction to the Anatomy of Terebratula* in DAVIDSON'S *Monograph on Fossil Terebratulæ*, published by the Palæontographical Society, 1853, pp. 15, 16, and Pl. III. fig. 1. This structure of the spaces in which the blood flows was first explained by HUNTER, and exists equally in insects and crustaceans. OWEN l. l. pp. 17, 18.]

[3] MECKEL'S *System der vergl. Anat.* VI. 1833, p. 60. In *Solenomya* the gills also are feather-shaped; see PHILIPPI in WIEGMANN'S *Archiv für Naturgeschichte*, I. 1835, s. 275.

[4] In *Anatina* and *Pholadomya* SOWERBY the gill-plates on each side are so grown together as to form a single gill; OWEN *Lectures on the Comp. Anat. of the invert.*

plates described are gills, BOJANUS entirely recedes; he thinks that the only office of these organs is the custody of the eggs, whence he does not name them gills, but brood-receptacles (*Bruthälter*). Accordingly he has described an entirely different organ, not noticed previously, as a respiratory organ[1]. According to his observations the venous blood, that flows back from the organs of the body, is conducted to an elongated venous sinus situated at the dorsal surface beneath the heart. Close to this sinus are two spongy, dark-green or brown sacs, which are very rich in vessels, and receive all the blood from the venous sinus. BOJANUS was of opinion that these organs serve for respiration, and are lungs; from each sac arises a single vascular stem, which runs along the two gills of its own side. From the parts which BOJANUS names lungs, come also some short vessels, which run immediately to the heart, but the greater part of the blood that flows in them goes to the two vascular stems of the gill-plates.

The investigations of BOJANUS have made us much more accurately acquainted with the circulation of the blood in *Lamellibranchiata*, than what had previously been written upon it. The mode, however, in which this anatomist explained what he observed, is exposed to many objections. If his opinions be not adopted, it is not clear what appellation ought to be assigned to the organs described by BOJANUS. At the present day it seems that these so-named lungs are very commonly regarded as kidneys[2]. On this supposition, however, it remains unexplained why they receive all the venous blood of the body. This circumstance deserves special consideration, whenever a conclusion is attempted concerning the nature of these organs. Hence it is that I offered, now more than twenty years ago, the opinion that these so-called lungs are venous sinuses, as much as the part that lies between them, which BOJANUS himself named *sinus venosus;* they

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*Animals*, p. 283. Also in *Lucina* and *Corbis* VALANCIENNES found only a single gill on each side; *Comptes rendus*, 9 Juin, 1845.

[1] L. H. BOJANUS *Sendschreiben à Mr le Chevalier* G. DE CUVIER *über die Athem- und Kreislaufwerkzeuge der zweischaaligen Muscheln insbesondere des Anodon cygneum. Mit abbildungen*, 4to. (Printed separately from OKEN'S *Isis* in 1820, Heft 7). POLI speaks in different parts of his work of this organ, under the name of *viscus testaceum*.

[2] TREVIRANUS *Zeitschr. f. Physiol.* I. 1824, s. 53; CARUS *Lehrbuch der Zootomie*, 2te Aufl. II. 1834, s. 650; V. SIEBOLD *Lehrb. d. vergl. Anat.* I. s. 281—284.

are parts which correspond to the lateral venous sinuses of the decapod crustaceans (see above, p. 605), and to the two lateral venous hearts in the *Cephalopoda dibranchiata*[1]. Consequently the two arterial stems of the gills convey venous blood, which, having become arterial in the gills, is brought back to the heart by four branchial veins (two on each side). The walls of these venous sinuses may at the same time be regarded as secreting organs, which correspond to the appendages of the veins in the *Cephalopoda*. Each of these sinuses, moreover, is situated in a cavity or a space with thin walls, to which the water has free access by a fissure which opens close to the external opening of the genital organs.

Besides the circulation of the blood in vessels and in spaces without proper walls, as already described, another system still of canals or interspaces has been discovered, that is filled with water in conchifers, as in many other invertebrate animals[2]. It is probable that in the description of the circulating system of the blood, a confusion with these canals has occasionally occurred[3].

It was generally supposed formerly, that all the conchifers were of one sex, not so much bisexual, as indeed all female, there being no other organs of propagation except ovaries[4]. But if such were really the case, these animals ought not to be styled female, but sexless. An organ for the preparation of germs could not, when the germ required no impregnation, be an ovary; the germ which, without the influence of *sperma* is developed into a new animal, ought rather to be named a detached bud than an

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[1] In a letter to my deceased friend NITZSCH of Halle, MECKEL'S *Archiv f. Anat. u. Physiol.* 1828, s. 502, and in the first edition of this Handbook, II. bl. 35. What V. SIEBOLD advances as my opinion, and with which he professes to agree, that the parts described by BOJANUS correspond to the appendages of the veins in *Cephalopods*, is not mine, but indeed a later guess of BOJANUS himself (*Isis* 1820), who in fact had too much love of truth to conceal that his opinion respecting the respiration of conchifers was something of a paradox (*eine in ironischer Anwandlung, etwas keck und paradox ausgesprochene Meinung*).

[2] DELLE CHIAJE *Memorie sulla storia e notomia degli animali senza vertebre*, II. p. 259, and foll. pp. 269, 270; V. BAER in FRORIEP'S *Notizen*, 1826.

[3] Compare on this point V. SIEBOLD *Lehrb. der vergl. Anat.* I. s. 279—281. [See LEYDIG *Ueb. Cyclas cornea* LAM., MUELLER'S *Archiv*, 1855, pp. 54—57, from whose observations it would seem that the opinion of DELLE CHIAJE, that the fine pores and canals of the water-system communicate with that of the blood, is perfectly correct.]

[4] Even in the work of DESHAYES, *Traité de Conchyliol.*, begun a few years back, this statement is found p. 284.

egg[1]. We have already seen above in the case of the sea-nettles and echinoderms, that the sexual glands (*ovaria, testes*) might agree entirely in position and external form, so that, without microscopic investigation of their contents, it could not be determined whether they were feminine or masculine, whether they served to prepare the germ or to impregnate it. In the *Brachiopoda* the ovary alone is known hitherto, which lies behind the liver; from the ovary the eggs arrive at the lobes of the mantle, and cover the blood-vessels that are distributed there[2]. In the *Lamellibranchiata* PREVOST discovered in 1823 distinct sexes in *Unio*[3]. In the male sex, in place of the ovary, a similarly formed part is found, filled with white fluid, which swarms with seminal animalcules. PREVOST saw neither from these nor from those that had ovaries any young ones proceed when he kept them apart, but did when two were placed in contiguity. These observations were confirmed some years afterwards by others of the same kind, of WAGNER, MILNE EDWARDS, and others, and especially by very exact investigations of C. T. VON SIEBOLD[4]. In the mean time, this interesting peculiarity is no new discovery of the last years; and the observations which have been alluded to tend to the confirmation rather of what had already been observed by LEEUWENHOECK a century and a half earlier[5]. The *spermatozoa* have a long thin tail and a conspicuously distinct body, like a knob, which is very small and elongated. The *testes* in the male individuals are situated at the same part as the ovaries in the females; they open at the same place, and appear in the arrangement of their blind tubes to agree with the ovaries. Now that it has been admitted that difference of sex exists in the

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[1] MUELLER'S *Physiologie*, II. p. 618.

[2] CUVIER could not trace the organs of propagation in *Lingula;* OWEN describes them very briefly in *Terebratula* and *Orbicula, Trans. Zool. Soc.* I. pp. 152—156, Pl. 22, fig. 11*f*, 16*r*, Pl. 23, fig. 11*w*, fig. 15*m*; in these figures the eggs are represented partly in the mantle; there are eggs also lying on the mantle, which O. F. MUELLER described and figured as *ovarium ramosum* in *Orbicula, Zool. Danic.* Tab. 4, fig. 7. [See, however, OWEN'S further description of the generative organs in *Terebratula*, in his *Introduction* cited above, p. 710 and Plate IH. fig. 1. He concludes that *Ter. flavescens* is dioecious.]

[3] *De la génération de la moule des peintres, Mém. de la Soc. de Physique et d'Hist. Nat. de Genève*, III. 1, pp. 121 and foll.

[4] See these observations, illustrated by figures, in MUELLER'S *Archiv*, 1837, s. 381—392.

[5] A. VAN LEEUWENHOECK *Vijfde vervolg der Brieven*, Delft, 1696, 4to, 95vte Missive, blz. 136—155; see especially blz. 145.

*Lamellibranchiata*, perhaps hereafter external sexual difference will be looked for. In *Anodonta*, at least, the females may be recognised by their more convex shells[1]. However all *Lamellibranchiata* are not of different sex; *Pecten*, for instance, according to MILNE EDWARDS, is hermaphroditic[2]; also in *Cyclas*, besides the ovaries, two *testes* are present[3].

The structure of the ovaries has, by the investigations of POLI, become known in many genera of *Lamellibranchiata*. The two ovaries lie on each side of the intestinal canal and the liver, and consist of tubes that divide into branches terminating blindly; they have often a proper colour, ordinarily red or rose-red, by which they are distinguished from the neighbouring parts. The eggs pass from the ovary by an aperture situated on each side of the foot or the abdomen, at the inside of the opening of the vacuities in which the venous sinuses are contained. In the same situation lie the apertures by which in the male conchifers the *sperma* is evacuated. Afterwards the eggs proceed along the foot into an opening between the foot and the inner gills, and arrive at the canal of the inner gills, which conducts to the cloaca. From here the eggs are carried to the lobes of the mantle, or they come outward and are brought by the respiratory streams from behind into the canal of the external gills, and deposited between the plates in the saccules of these gills, as in *Unio* and *Anodonta*[4].

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[1] V. SIEBOLD *op. cit.* s. 391; KIRTLAND appears to have remarked this difference in *Unio* also.

[2] *Ann. des Sc. Nat.* 2e Série, XVIII. 1842, *Zoologie*, pp. 321, 322, Pl. 10, fig. 1.

[3] WAGNER found *spermatozoa* in all the individuals of *Cyclas cordata* which he investigated; WIEGMANN'S *Archiv*, 1835, II. s. 218, Tab. III. fig. 8. The presence of two *testes* and two *ovaria* in genus *Cyclas* was observed by V. SIEBOLD, MUELLER'S *Archiv*, 1837, s. 383, 384. [See on the genital organs of *Lamellibranchiata*, H. LECAZE-DUTHIERS *Ann. des Sc. Nat., Zool.* 4ième Série, Tom. II. pp. 155—248. He adds *Ostrea*, so much contested, to the list of the hermaphrodites. *Pecten*, which is usually bisexual, has one species (*Pecten varius*) unisexual, whilst *Cardium*, usually unisexual, has *Cardium serratum* and *Card. lævigatum* bisexual. In some hermaphrodites, the sexual organs, though united in the body of the same animal, are quite distinct (*Pecten*, &c.), in others they are quite confused, (*Ostrea*).]

[4] The figure of POLI *Testac. utriusq. Sicil.* I. Tab. IX. fig. 18, gives a good idea of these chambers formed by transverse septa, triangular and much elongated, which have their bases turned to the dorsal side of the gills. POLI and most observers have found the eggs in the external gills alone, BOJANUS occasionally found some in the internal also. Thus the respiratory function is not prevented by these eggs; but only partially interrupted, and since there are many *conchifera* in which the gills do not serve for the reception of eggs, there is the less reason for refusing to these organs the function of

Here the eggs remain for development. Since the young Anodonts and Unios in the early period of life have a form differing from the perfect animal, they have by some writers been regarded as parasites that live in the gills[1]. It is almost needless to say that, in the *Lamellibranchiata*, where the sexes are distinct, there is no copulation. The eggs must leave the ovarium previously to impregnation.

The nervous system was by POLI, whose investigations have contributed so much to the knowledge of the structure of conchifers, described as aqui-vascular system, since the wide *neurilema* admitted impletion with quicksilver. MANGILI contested this opinion. He observed four nervous ganglia in *Anodonta*, two at the side of the mouth, one, the largest of all, in the foot, and a fourth under the posterior occludent muscle of the shell, from which ganglion the nerves for the gills and the mantle arise. All these ganglia are mutually connected by nerve-filaments[2]. This may be regarded as the first exposition, in some measure accurate, of the nervous system in this class. As the rule, three central nerve-masses may be admitted in the *Lamellibranchiata*, each consisting of two lateral ganglia, of which, however, the first two alone are constantly distinct from each other. These lie near the mouth, and are connected by a longer or shorter transverse arched filament, a commissure which runs in front of the mouth. On each side there arises from these ganglia a long nerve-cord that runs to the posterior nerve-mass, the *ganglia abdominalia*, often connected in a single ganglion, and thus forms a wide ring which may be compared to the œsophageal ring in other invertebrate animals. The second

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respiration, so generally attributed to them; to say nothing of the male individuals in which the temporary function for the gills of brooding organs entirely falls to the ground.

[1] J. RATHKE (*Shrivter of nat. Selskabet*, IV. 1, 1797, pp. 166, 167, and after him L. JACOBSON *Kongel. Danske Videnskab. Selskabs Naturvid. og Mathem. Afhandlinger*, III. 1828, pp. 268, 269), described the animal living in the gills as a distinct species under the name of *Glochidium*. The observations of V. BAER (MECKEL'S *Archiv*, 1830, s. 331) and especially of CARUS (*Neue Untersuchungen üb. d. Entwickelungsgesch. unserer Flussmuschel*, Leipsig, 1832, 4to, printed separately from the *Act. Acad. Cæs. Leop. Carol.* XVI. 1) have now cleared this matter up. The young animals have a triangular bivalve shell, which gapes open, and has at the outer margins an appendage or hook turned inwards and furnished with small spines. Comp. also QUATREFAGES, *Ann. des Sc. Nat.* sec. Série, V. 1836, *Zool.* pp. 321—336, Pl. 12.

[2] *Nuove Richerche zootomische sopra alcuni specie di Conchiglie bivalvi*, Milano, 1804; translated into German in REIL'S *Archiv*, IX. s. 213—220, Taf. X*b*.

nerve-mass, the *par pedale*, also connected with the first ganglia by two shorter strings, is, in those genera that have no foot, feebly developed, or according to GARNER, even absent. The nerve-ganglia are usually distinguished by a red or orange colour[1]. The nervous system of the *Brachiopoda* is not yet perfectly known, but seems to be formed after a different *typus*[2].

Amongst the parts which may be regarded as the seats of senses, the conical *cirri* are first to be noticed, which are present sometimes along the entire margin of the mantle of the *Lamellibranchiata*, or on some parts of the mantle, at the opening of the *siphon* for example, and which in the *Brachiopoda* are changed for long, stiff, glistering hairs. The mouth, moreover, in the *Lamellibranchiata* is surrounded by two pairs of transversely striped organs of touch of considerable size, triangular, elongated or oval laminæ, which some consider to be accessory gills, from their external resemblance to these organs. In the *Brachiopoda* there are two long arms, beset pectinately with filaments like a fringe, situated at the side of the mouth, where they are rolled up in a spiral form, and concealed within the shell. Organs of vision have, of late years, been shewn by microscopic investigation to be present in *Pecten*, *Spondylus*, and many other genera amongst the *Lamellibranchiata*, as green, red-yellow, or brown tubers, shining brightly, and often set upon a small pedicle at the margin of the mantle. In different species more than a hundred such eyes have been counted[3].

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[1] Compare R. GARNER *On the nervous system of Molluscous Animals, Trans. of Linn. Soc.* XVII. 1835, pp. 485—488, Pl. 24; BLANCHARD *Observations sur le Système nerveux des Mollusques lamellibranches, Ann. des Sc. nat.*, 3ième Série, III. 1845, pp. 321—340, Pl. 12. Here may be found a copious historical review of this subject. The two small nerve-ganglia that lie near the oval ganglia in *Ostrea* (BRANDT and RATZEBURG *Medizin. Zool.* II. s. 340, 341), BLANCHARD regards as answering to the *par pedale* (here wanting according to GARNER). Nervous branches that arise from the lateral commissural string of the first and hindmost pair, on which in some species (*Solen*, *Arca*) even gangliform swellings are observed, correspond, so it appears, to the sympathetic nervous system of articulate animals, especially to the lateral portions of it in the crays, which in like manner arise from the collar round the neck (see above, p. 618). Those lamellibranchiates, which are provided with a tubular prolongation of the mantle, have often between the muscles, that retract the tube, small nerve-ganglia in addition.

[2] CUVIER *Mém. sur la Lingule*, p. 8, speaks very indecisively on this point; OWEN describes a nerve-ganglion between the basal pieces of the two arms, and two others at the side of the mouth. *Trans. of Zool. Soc.* I. p. 156. [On the nervous system of *Terebratula* see OWEN *Introduct.* &c. pp. 11, 12 (cited above, p. 710).]

[3] POLI spoke of such eyes *smaragdino colore coruscantes*, which are situated on the larger *cirri* of the border of the mantle in *Spondylus* (II. p. 107) and *Pecten Jacobæus*

As auditory organ, SIEBOLD regards a part met with by him in *Cyclas*, *Anodonta*, *Unio*, *Mya*, *Cardium*, *Tellina*, &c., an organ situated in front of and near to the nerve-mass of the foot. Here namely on both sides he found a vesicle in which a flat, round, transparent nucleus is in free motion. The nucleus is a concrement comparable to the *lapilli* in the auditory sac of the bony fishes[1]. Neither of this enigmatical organ nor of eyes has any vestige been met with in the *Brachiopoda*.

The motions of these animals are very simple. Many *Lamellibranchiata*, and all the Brachiopods, are fixed to their places, and are not able to move from them. Other conchifers have a springing motion by means of the *foot*, a name given to a production of the abdomen which is muscular and very firm, possesses great contractility and irritability, and may assume very different forms[2]. By means of it bivalves move at the bottom of the water in which they live.

The geographic distribution of conchifers deserves a more special investigation than has hitherto been bestowed upon it. All conchifers live in water, part of them in fresh water, but the greatest part in the sea. Amongst the genera that live in the sea are some of which species are met with in all parts of the world, as genera *Solen*, *Mya*, *Anatina*, *Mactra*, *Tellina*, *Lucina*, *Donax*, *Venus*, *Cardium*, *Arca*, *Pectunculus*, *Mytilus*, *Pecten*, *Ostrea*. It is however far from the fact that all these genera are found in like manner in different seas; of the genera *Venus*, *Cardium*, *Arca*, *Ostrea*, the species are much more numerous in the Indian Sea and the South Pacific, than in seas of the northern hemisphere. *Glycimeris* appears to be a northern form, of which

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(ib. p. 153); they are particularly large and conspicuous in the species last named (Tab. 27, figs. 5, 14); POLI was not able to investigate their internal structure; and the later writers on the molluscs neglected this peculiarity altogether. Only within the last few years has it been adequately illustrated by GRUBE (MUELLER'S *Archiv*, 1840, s. 24, Taf. III. figs. 1, 3), KROHN (ib. s. 381—386, Taf. XI. fig. 16) and WILL (FRORIEP'S *Neue Notizen*, XXIX. Bd. January, 1844, No. 622, 623).

[1] C. TH. VON SIEBOLD *Ueber ein räthselhaftiges Organ einiger Bivalven*, MUELLER'S *Archiv*, 1838, s. 49—54 (transferred to *Ann. des Sc. nat.*, sec. Série, X. *Zool.* p. 312), and WIEGMANN'S *Archiv*, 1841, *Ueb. d. Gehörorgan der Mollusken*, s. 148 and foll., *Ann. d. Sc. nat.*, sec. Série, XIX. p. 193, Pl. 2 B, fig. 1. [Also LEYDIG *Ueber Cyclas cornea*, MUELLER'S *Archiv*, 1855, pp. 51, 52. Pl. VI. fig. 18.]

[2] See POLI, I. *Introd.* p. 37.

genus the only species hitherto known, *Glycimeris siliqua*, is found very abundantly on the great bank of Newfoundland. More numerous, on the other hand, are the forms which occur exclusively in warm seas or in the southern hemisphere, or of which one or only a few species are met with in the Mediterranean or the Red Sea. We mention here the genera *Crassatella*, *Tridacna*, *Hippopus*, *Malleus*, *Avicula*, *Meleagrina*, *Spondylus* (and the genus *Plicatula* united with it), *Vulsella*, *Placuna*. The frequent occurrence of well-preserved remains of this class in different mountain-strata affords an assistance of the highest interest to the investigations of geologists towards a true knowledge and distinction of those strata. Of some genera the extinct species are much more numerous than those now living; some genera which formerly peopled the sea have entirely disappeared in the present period of the history of the earth. It is remarkable that of the genera now living and which also count extinct species, whenever these last are very numerous, by far the most of the living species are now met with either exclusively, or principally, in the Indian ocean and in the southern Pacific. Of the genus *Trigonia*, a single living species alone is now known, and this is found in the South Sea at New Holland, whilst numerous fossil species belong to it, especially from the Jura- and chalk-formations. The genera *Spondylus*, *Lima*, *Avicula*, *Crassatella*, *Arca* and others, tend also to prove the same.

Regarding the fresh-water conchifers, we would call attention to the great number of species of the genus *Unio*, which occur in the western hemisphere, especially in North America.

The *Brachiopoda* in their geological and geographical distribution offer much that is peculiar. Of *Orbicula* and *Terebratula* species occur both in the north and in the south; species are known from the Indian ocean and from the Mediterranean, from the South Sea on the west coast of America, and from the North Sea. At the same time of these genera the species in the southern seas are more numerous, and the few species of *Lingula* are all from the southern hemisphere. Extinct species of *Terebratula* are uncommonly numerous, and occur in very old as well as in more recent formations. Thus the *Brachiopoda* make one of the few forms which are restricted to no limited period of the history of the earth, and have survived its various catastrophes.

# SYSTEMATIC

# ARRANGEMENT OF CONCHIFERA.

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## CLASS XII.

### CONCHIFERA.

ANIMALS without distinct head, covered on each side with a lamina of mantle. Shells two, incumbent on mantle. Heart aortic. Respiration branchial, with branchiæ mostly lamellose, running out near the margins of body on each side, covered by mantle; in some the mantle itself discharging the office of branchiæ. Some hermaphrodite, others with sex distinct: all aquatic.

### ORDER I. *Palliobranchiata* or *Brachiopoda.*

Body depressed, covered with mantle, bilobed, open. Branchiæ grown to the mantle or not distinct from mantle. Heart double, arterial. Two long arms convoluted in form of a spiral, armed with cirri or cilia. Mouth simple at the base of arms. Shell bivalve, affixed, sessile or petiolate, adhering to mantle by several oblique muscles.

Family I. *Brachiopoda.* Characters those of the order.

On this order and family may be compared :—

CUVIER *Mém. sur l'Animal de la Lingula, Ann. du Mus.* I. 1802, pp. 69—80, Pl. v. reprinted in his *Mémoires sur l'Hist. et l'Anat. des Mollusq.* No. 21.

BRODERIP *Descriptions of some new species of Brachiopoda, Trans. Zool. Soc.* I. pp. 141—144.

OWEN *On the Anatomy of the Brachiopoda; ib.* pp. 145—164, Pl. 22, 23 (both these memoirs are translated and reprinted in the *Ann. des Sc. Nat.*, sec. Série, III. 1835, pp. 26—30; 52—77).

R. OWEN *Lettre à* M. MILNE EDWARDS *sur l'appareil de la Circulation chez les Mollusques de la classe des Brachiopodes, Ann. des Sc. Nat.*, 3ième Série, III. 1845, *Zool.* pp. 315—320, Pl. 4.

W. KING *Remarks on certain Genera belonging to the Class Palliobranchiata, Annals of Natur. History,* XVIII. 1846, pp. 26—42; 83—94.

OWEN *On the Anatomy of Terebratula, Introduction to the British Fossil Brachiopoda* by DAVIDSON. Printed for the Palæontographical Soc. 1854, pp. 4—22.

The chief characteristic of this division consists in the respiratory organs. In *Ligula*, on each lobe of the mantle on the inside, two main trunks are seen that run longitudinally and return the blood to the heart, which is double, as we have seen above, at the part where the two are most remote, and converge obliquely to the free margin of the lobe of the mantle in the form of an inverted V. Lateral and parallel branches, that make a right angle with the trunk, form an elegant pectinated design on the laminæ of the mantle. It is these vascular divisions which compose the respiratory organs; the gills are, therefore, attached to the mantle, or rather the mantle itself is the seat of respiration. From this disposition that which presents itself in *Orbicula* and *Terebratula* differs more in appearance than in reality. The respiratory function is not limited here, as in *Ligula*, to a part of the mantle, but is distributed over the whole of it, whilst two vascular stems on one lobe and four on the other are formed from numerous branches, and bring back the arterial blood to the double heart (OWEN *Transact. Zool. Soc.* I. pp. 147, 148, 154). The two hearts do not receive the blood immediately, however, in these molluscs, from the stems of the branchial veins, but these last pour it into a *sinus*, from which it is taken up by the free and wide opening of the two auricles of the heart (*Ann. des Sc. Nat.* 3ième Série, III. pp. 316—319).

A second character of this order is afforded by the two so-named arms, which lie rolled up with their convex side outwards near the mouth, and are margined with *cirri* or filaments. In *Terebratula*, where these filaments are long and fine, these two arms thus acquire the external appearance of gills, and have accordingly been so named by earlier writers, *ex. gr.* PALLAS *Miscell. Zool.* 1766, p. 182,

GRUNDLER *Naturforscher*, II. 1774, pp. 82, 83. The arms have in their axis a tendinous canal closed at the extremities, which, according to OWEN, is filled internally with a fluid. Muscular fibres which surround the canal force, in his opinion, this fluid to the outer extremity, and thus cause the arms to unfold.

In the third place the *Brachiopoda* are characterised by the absence of an elastic ligament, which in the Lamellibranchiates exists at the hinge of the shells and works antagonistically with the adductor muscles. Thus the shell is opened here by the arms, or also, in *Terebratula*, by the elasticity of a composite apparatus of thin calcareous loops which are attached within, to the surface of the lesser imperforate shell. Hence arises a more complex disposition of the muscular system, which is formed of different oblique bundles in place of the single or double adductor muscle found in the Lamellibranchiates.

## I. Shell hingeless.

*Lingula* BRUG., LAM. Shell subequivalve, flattened, oblong, thin, gaping at both ends, affixed by a peduncle fleshy, cylindrical, hollow internally.

Sp. *Lingula anatina* LAM., BLAINV. Pl. 51, fig. 3, GUÉRIN *Iconogr., Moll.* Pl. 36, fig. 1; from the East Indian Ocean. Formerly detached shells alone of this animal were known; such a single shell is figured by RUMPHIUS *Amb. Rariteitk.* Tab. XL. fig. L. LINNÆUS named such an one *Patella unguis*. The first account of two shells connected together was given by CHEMNITZ (*Naturforscher*, XXII. 1787, pp. 23—32, Tab. III.).

Of late years a few other living species of this genus have been discovered. Compare BRODERIP l. l. and on the anatomy of *Lingula*, besides CUVIÉR and OWEN, as cited above, also C. VOGT *Neue Denkschriften der allg. Schweizer Gesellschaft f. d. ges. Naturwiss.* VII. Neuchatel, 1845, *mit 2 Taf.*

Fossil species also of this genus are found, especially in the Silurian formation, also in the mountain-lime. In the *Muschel-kalk* and *bunter Sandstein Lingula tenuissima* is found, BRONN *Leth. geogn.* Tab. XII. fig. 6 B.

*Orbicula* CUV., LAM. Shell inequivalve, orbicular. Affixed valve plane, cloven in the disc; superior valve conical.

Sp. *Orbicula Norwegica* LAM., *Patella anomala* MUELL., *Zool. Danic.* Tab. V., BLAINV. *Malacol.* Pl. 55, fig. 5; attached to rocks and shells in the North Sea;—*Orbic. lamellosa* BRODER., *Trans. Zool. Soc.* Tab. 23, fig. 2, on the coast of Peru, &c.

*Note.*—Genus *Discina* LAM. to be abolished, not being distinct from *Orbicula*; see G. B. SOWERBY *Trans. Linn. Soc.* XIII. p. 472.

*Crania* RETZIUS, BRUG. Shell inequivalve, suborbicular. Affixed valve plane, with four muscular impressions internally, the two middle almost confluent to form one.

Sp. *Crania ringens* HŒNINGH., *Anomia turbinata* POLI, *Test. utr. Sicil.* II. Tab. 30, BLAINV. *Malac.* Pl. 59, fig. 2; Mediterranean. This species is commonly confounded with *Anomia craniolaris* L., which is fossil, like many other species, from the chalk-formation.

Compare A. J. RETZIUS *Crania oder Todtenkopfs-Muschel, Schriften des Berliner Gesellsch. naturforschender Freunde*, Bd. II. s. 66, SOWERBY *Trans. Linn. Soc.* XIII. pp. 469—472, Tab. 26.

II. Shell furnished with hinge.

*Calceola* LAM. Fossil genus [of the Devonian period, DAVIDSON *Introduct.* &c. p. 121].

*Thecidea* DEFR.

*Terebratula* LHWYD, BRUG. (species of *Anomia* L.). Shell inequivalve, subtrigonal. Apex of larger (ventral) valve perforated by a round aperture transmitting a short affixed peduncle. Hinge with two teeth. Internally two calcareous branches, slender, arcuate, rising from the disc of the lesser (dorsal) valve, forming the support of the arms.

[The *Terebratulidæ* have been subdivided, in the interest of Geology, into genera and sub-genera, chiefly according to the extent and form of the calcareous appendage. In the true *Terebratulæ* the appendage, variable in length, is formed of two riband-shaped lamellæ fixed to the crural base alone, and more or less folded back upon itself.

*Terebratulina* D'ORBIG. The crural processes united to form a calcareous band behind the mouth, and the reflected loop always in front of the mouth.]

Sp. *Terebratula* (*Terebratulina*) *caput serpentis* LAM., *Anomia caput serpentis* L., *Encycl. méth., Vers.* Pl. 246, fig. 7, BLAINV. *Malacol.* Pl. 52, fig. 6; in the Atlantic ocean, the North Sea, the Scottish coast.

[*Terebratella* D'ORBIG. Differs from *Terebratula* by its loop being doubly attached; the lamellæ proceeding from the crural base, before attaining their greatest length, sending off a flat horizontal process likewise affixed to a more or less elevated longitudinal septum.]

Sp. *Terebratula* (*Terebratella*) *dorsata* LAM., BLAINV. *Malacol.* Pl. 51, fig. 1, from the straits of Magellan, &c.

[*Megerlia* KING, *Krausia* DAVIDSON, *Morrisia* DAV., *Magas* SOWERBY, *Bouchardia* DAV., *Agriope* DELONGSCHAMPS, *Megathyris*

D'ORB., *Rhynconella* FISCHER (anatomy by OWEN *Zool. Trans.* Vol. I. pt. 2). On all the genera of this division see especially DAVIDSON on the classification of recent *Brachiopoda*, *Ann. and Mag. of Nat. Hist.*, new ser. IX. 1851, pp. 361—377.]

Much more numerous than the recent species are the fossil, amongst which we cite that alone, on account of its peculiarly symmetrical form, which FABIO COLONNA likened to two mussels joined together: *Terebratula discoïdea* LAM., *Terebratula diphya* COL., VON BUCH *Encycl. méth., Vers.* Pl. 240, fig. 4, from the chalk-formation, especially found in Italy.

Comp. L. VON BUCH *Ueber Terebrateln mit einem Versuch sie zu classificiren und zu beschreiben, mit 3 lithogr. Tafeln*, Berlin, 1834, 4to. (*Abhandl. der Akad. der Wissensch. in Berlin, Physik. Klasse* 1833).

*Spirifer* SOWERBY, *Delthyris* DALM., *Trigonotreta* KOENIG, BRONN. Foramen of larger valve triangular, marginal. Supports of arms rolled spirally.

Comp. SOWERBY *Linn. Transact.* XII. p. 514, fig. 9;—L. VON BUCH *Ueber Delthyris oder Spirifer und Orthis, mit 2 lithogr. Taf.* Berlin, 1837. 4to. (*Abh. der Akad. in Berlin, Physik. Kl.* 1836).

The shells are usually much extended in the breadth, as, *Spirifer speciosus* BRONN, *Leth. geogn.* Tab. II. fig. 15.

All the species belong to the older, in great part to the transition-formations. In the *Lias* or lowest oolitic strata, the last species of this genus is found, *Spirifer Walcottii*, which is thus met with no more amongst the remains of living creatures.

*Productus* SOWERBY, *Strophomena* RAFIN., BRONN, *Leptena* DALM. Hinge linear, straight. Shell inequivalve, alate, almost semiorbicular, with larger valve gibbous, imperforate.

An entirely extinct genus from the oldest periods of the history of our earth. DESHAYES thinks that these conchifers were not attached, but moved freely like most of the lamellibranchiates. Sp. *Productus tubuliferus* DESH., *Strephomena aculeata* BRONN, *Lethæa geogn.* Tab. III. fig. 1, &c. Some writers distinguish *Strophomena* as a distinct genus from *Productus*. See on this and other genera which we here omit, W. KING in *Ann. and Magaz. of Nat. Hist.* Vol. 18, 1846, pp. 26—42 and pp. 83—94, and on *Productus* L. VON BUCH in *Abhandl. der Akad. in Berlin, Physik. Klasse*, 1841. The admirable *Monograph* of DAVIDSON, *On the British Oolitic and Liassic Brachiopoda*, with an introduction on the classification, and a chapter by CARPENTER, *On the intimate structure of the shells of Brachiopoda*, besides that of OWEN, already cited on the Anatomy, were published for the Palæontographical Society of London in the years 1851, 1852, 1854, and are especially referred to in this division.

## ORDER II. *Lamellibranchiata.*

Body compressed, covered on both sides by a lamina of the mantle. Branchiæ at the sides of the body placed under each lobe

of mantle, mostly lamellose, two on each side, more rarely pectinate, composed of thin fimbriæ or laciniæ crowded together. Four lamelliform tentacles in by far the most, oval or triangular, placed in pairs at the sides of mouth. Two lateral shells incumbent on mantle, conjoined by an elastic ligament at the back.

On the internal structure of these lamellibranchiate conchifers, what was needful has been already said above. The beard-threads, named *byssus*, still require a short notice. At the foot of the conchifers (see above, p. 717) there is often situated a bundle of hairs or filaments to which the name of *byssus* has been given; sometimes these filaments are united into a common mass; they are attached in a cavity at the base of the foot by a peculiar substance secreted there (conjunctive matter). From the cavity a furrow runs to nearly the extremity of the foot, and along this furrow is situated the glandular tissue by which the *byssus* is secreted. RÉAUMUR maintained that these horny threads were spun just like the web of caterpillars and the nets of spiders. With the assistance of the muscular foot these threads are directed to determinate situations and caused to adhere there firmly by their broad disciform extremities; they grow again if cut off.

Comp. A. MUELLER *de Bysso Acephalorum Acced.* Tab. II. Berolini, 1836, 4to, and in WIEGMANN'S *Archiv*, 1837, s. 1—39, Tab. I. II. Various opinions of writers on these filaments were noticed in the first edition of this Handbook, II. blz. 37.

Several conchifers, which are not attached by *byssus*-filaments, grow fast by one of the two valves to rocks or different substances found in the sea. That some of them move freely and get over the ground with their foot has been already noticed (p. 717). The two valves of the shell are separated from each other by the elastic ligament situated at the hinge behind the point (p. 682). White compact muscular fibres, which run transversely from one valve to the other, close the shell on the other hand. These bundles leave impressions on the interior of the shell, two on each valve, the one before, the other behind, if, as in most of these animals, two adductor muscles be present; if, on the contrary, as in the oyster, there be only one, then only a single muscular impression is to be seen on each valve, situated nearly in the middle.

POLI made many experiments with regard to the force of these muscles in living conchifers. Thus he states, for instance, that the adductor muscles in the animal of the Noah's Snell (*Pectunculus*) can overcome the resistance of 50 lbs., and that more than 70 lbs. are required to tear them asunder. The shell weighed only one pound, the animal itself only 4 ounces.

A. *Monomyaria.* Muscular impression single, subcentral. Internal ligament received in a cardinal pit, partially visible on the outside in some, mostly included.

The single adductor muscle here corresponds to the posterior adductor of those conchifers that have two of them. All the *single-muscled* conchifers live in the sea.

Family II. *Ostracea.* Mantle open. Foot none or a small rudiment of foot, not byssiferous. Shell irregular, lamellose.

*Anomia* BRUG. (Species of genus *Anomia* L.). Shell inequivalve, thin, one valve flat, perforate or emarginate towards the point, the other larger, more gibbous at the base. Animal (*Echion* POLI) with foot small, tentacles at mouth none, margin of mantle cirriferous, adhering to marine bodies by a muscular cord perforating the shell and inserted into the calcareous cover.

The name *Anomia* was first employed by F. COLUMNA (*De Purpura*, Romæ, 1616) and given to those *conchifera* which are now named *Terebratula.* LINNÆUS united with these some very different conchifers also under the name of *Anomia,* although what he says in the description of the characters of this animal (*Sys. Nat.*, ed. 12, I. p. 1150) applies to *Terebratula* alone. BRUGUIÈRE (*Encycl. méth., Vers.* I. p. 70) was the first who gave the name of *Anomia* to the present genus and placed it in the neighbourhood of the oysters. From these, however, it differs by many essential characters, so that DESHAYES has placed it even in a separate family. There are properly three muscles of which the impressions are seen on the convex valve, but on the flat valve only a singular muscular impression appears. This impression is that of the muscle which corresponds with the central depressor of the oyster; the two other muscles, which are attached to the convex valve, go through the aperture of the flat valve and fix themselves to the calcareous cover, which is often very hard, whence it is named by several writers a little bone (*ossiculum*). By that cover the shell is attached to other *conchifera* or to rocks. See DESHAYES *Dict. Univ. d'Hist. Nat.* I. 1841, pp. 557—559, and the figures of the three muscles in POLI *Testac. utr. Sicil.* Tab. 30, fig. 1, and in CUV. *R. Ani., éd. ill., Moll.* Pl. 79.

Sp. *Anomia Ephippium* L., LISTER *Conch.* 204, CHEMN. Tab. 76, figs. 692, 693, BLAINV. *Malacol.* Pl. 59, fig. 31, CUV. *R. Ani., éd. ill., Moll.* Pl. 79; Mediterranean, Atlantic; this species is very flat, the shell is mostly of a whitish colour;—*Anom. cepa* L., POLI Tab. 30, figs. 1, 8, is more convex,

smaller, reddish-purple, and is found in the same seas. The species of *Anomia* are difficult to characterise, and are not yet sufficiently distinguished. The fossil species occur especially in tertiary formations.

*Placunanomia* BRODER.

Comp. *Proceedings of the Zool. Soc. of London*, 1832, pp. 28, 29.

*Placuna* BRUG. (Species of *Anomia* L.). Shell free, subequivalve, flattened, thin, lamellose. Hinge interior, with two linear, divaricate crests, converging in the apex in one valve, received in two similar grooves in the other valve. Animal unknown.

Sp. *Placuna placenta*, *Anomia placenta* L., BLAINV. *Malac.* Pl. 60, fig. 3, GUÉRIN *Iconogr.*, *Moll.* Pl. 27, fig. 7, Indian Sea;—*Placuna sella* LAM., CHEMN. Tab. 79, fig. 714, HOUTTUYN *Nat. Hist.* I. 15, Pl. 119, &c. (under the name of *Ostrea ephippium*), &c.

*Carolia* CANTRAINE.

Comp. *Bulletin de l'Acad. royale des Sc. de Bruxelles*, V. 1838, pp. 111—113.

*Ostrea* L. (in part), BRUG. Shell adhering, inequivalve, lamellose, irregular, with left valve inferior, affixed, and right superior, plane, thinner. Hinge edentulous, a little cardinal pit receiving the ligament. Animal (*Peloris* POLI) with body compressed, foot none, margins of mantle thick, furnished with a double row of short fimbriæ.

Sp. *Ostrea edulis* L., BASTER *Natuurk. Uitsp.* I. pp. 71—81; BLAINV. *Malacol.* Pl. 60, fig. 1, POLI *Testac. utr. Sicil.* II. Tab. 29, fig. 1, CUV. *R. Ani., éd. ill., Moll.* Pl. 72, fig. 1; Oyster, *Œster*, *Huitre*, *Auster;* in the North Sea, Mediterranean, &c.; on the sea-banks at the Helder and on the Texel. This well-known species differs much in size and in the form of the shell, as will appear at once from a comparison of the figures cited. The oysters fished on the oyster-banks of Zealand become large in a shorter time than the English, and have flatter and less hard shells. Compare on Oyster-banks, besides BASTER loc. cit. CARBONNEL in *Magasin de Zool.* par GUÉRIN, 1845.

*Ostrea virginiana* LIST., GMEL., LISTER *Conch.* Tab. 200, fig. 34, Tab. 201, fig. 35, *Encycl. méthod., Vers.* Pl. 79, figs. 1—5; from the coast of N. America, differs by its greatly elongated form, and attains the remarkable length of 2 decimeters (nearly 8″).—By its margin folded in a singular manner at acute angles and its violet-red colour, is distinguished *Ostrea crista galli* CHEMN., *Mytilus crista galli* L., RUMPH. *Amb. Rariteitk.* Tab. 47, fig. D, BLAINV. *Malac.* Pl. 60, fig. 2, GUÉRIN *Iconogr.*, *Moll.* Pl. 24, fig. 7.

There are many fossil species of this genus both in the secondary and tertiary formations. Comp. LAMARCK *Ann. du Mus.* VIII. pp. 159—166;

XIV. Pl. 20—22, 23, figs. 1, 2. In the mount of St Peter is found *Ostrea larva* of which the elongated crooked shell with folded margins has some resemblance to the larva of an insect.

In some species the inferior shell, when the individuals are older, is curved upwards at the point and very thick. Of these LAMARCK formed his genus *Gryphæa*. (Sp. *Gryphæa angulata* LAM. from the coast of Peru.) These forms in the fossil state especially abound in the Oolite and Lias formations (as *Gryphæa arcuata* LAM., BLAINV. *Malac.* Pl. 59, fig. 4, BRONN *Lethæa*, Tab. 19, figs. 1 *a*, *b*); hence the name *Gryphite-limestone*, in geological works. In *Exogyra* SAY, SOW. the point is not bent upwards, but sideways. Species of this form occur especially in the chalk-formations.

Family III. *Pectinidea*. Mantle open with margin thick, tentaculate, often ocelliferous. Foot small. Shell regular or subregular, solid, often marked by longitudinal ribs, mostly auriculate.

*Spondylus* L. Shell inequivalve, adherent, mostly auriculate, rude or muricate. Hinge with two strong teeth in each valve and pit of ligament intermediate. Animal (*Argus* POLI) with body compressed and margin of mantle cirrate and ocelliferous. Foot small, disciform, supplied with a middle cylindrical filament sustaining an oval capitulum. Adductor muscle very large, central.

Sub-genus: *Plicatula* LAM. Shell inauriculate, plicate; inferior valve without external cardinal area.

Sp. *Spondylus plicatus* L., *Plicatula ramosa* LAM., CHEMN. *Conchyl.* Tab. 47, figs. 479, 480;—*Plicatula cristata* LAM., BLAINV. *Malac.* Pl. 62, fig. 2, GUÉRIN *Iconogr., Moll.* Pl. 25, fig. 9, &c. There are also fossil species of this form.

Sub-genus: *Spondylus* LAM. Shell mostly auriculate. Inferior valve produced beyond the hinge, area in superior trigonal, flat, mostly divided by a median furrow.

Sp. *Spondylus Gœderopus* L., POLI *Test. utr. Sicil.* II. Tab. 21, figs. 20, 21, Tab. 22, *Encycl. méth., Vers.* Pl. 190, fig. 1; in the Mediterranean;—*Spondyl. americanus* LAM., GUÉR. *Iconogr., Moll.* Pl. 25, fig. 8, &c.

Fossil species of *Spondylus* are found in the chalk-formation. To *Spondylus*, moreover, some fossil genera, whose characters are of no sufficient value, are referred by DESHAYES, as *Podopsis* LAM., *Pachytes* DEFR., *Dianchora* SOWERBY. Comp. *Ann. des Sc. natur.* XV. 1828, pp. 427—434, and the second edition of LAMARCK *Hist. nat. des Ani. s. vertèbr.* VII. pp. 195—198.

*Hinnites* DEFR. Shell irregular, subovate or orbicular, auriculate, affixed. Hinge edentulous, pit of ligament narrow, deeply cut out.

Comp. DEFRANCE *Dict. des Sc. natur.* XXII. 1821, pp. 169, 170, DESHAYES *Dict. class. d'Hist. nat.* VIII. pp. 200, 201. This genus stands as in the middle between *Spondylus* and *Pecten*. Besides the fossil species upon which DEFRANCE has founded it (*Hinnites Cortesii*, BLAINV. *Malac.* Pl. 61, fig. 1), DESHAYES refers to it *Pecten sinuosus* LAM., *Ostrea sinuosa* GMEL.

*Pecten* BRUG. (Species of *Ostrea* L.). Shell free, inequivalve, mostly ribbed with longitudinal rays, auriculate, with apical margin straight and apices contiguous. Hinge edentulous, with small cardinal pit internal, receiving the ligament. Animal (*Argus* POLI) orbicular, with mantle margined by cirri and ocelliferous tentacles, the foot small, sometimes byssiferous.

Sp. *Pecten Jacobæus* LAM., *Ostrea Jacobæa* L., POLI *Test. utr. Sicil.* Tab. 27, figs. 1, 2; BLAINV. *Malacol.* Pl. 60, fig. 4;—*St James' shell*, Mediterranean; the shell is with us often used for stewing oysters, but the animal itself is, when roasted, very agreeable according to POLI. This species also is found fossil in newer tertiary formations in Italy.—*Pecten pleuronectes* LAM., *Ostrea pleuronectes* L., RUMPH. *Amb. Rariteitk.* Tab. 45, figs. A, B, BLAINV. *Malac.* Pl. 60, fig. 5, CUV. *R. Ani., éd. ill., Moll.* Pl. 75, fig. 1. A very numerous genus, of which many extinct species are found in the secondary formations.

*Pedum* BRUG. Shell free, inequivalve, elongato-trigonal. Hinge edentulous. Inferior valve emarginate near the point. Animal with mantle cirri and ocelliferous tentacles. Foot byssiferous, the byssus passing through the excised valve.

Sp. *Pedum spondyloïdeum* LAM., *Encycl. méth., Vers.* Pl. 178, BLAINV. *Malac.* Pl. 62, fig. 6, CUV. *R. Ani., éd. ill., Moll.* Pl. 76, fig. 4, DESHAYES *Conchyl.* Pl. 48, figs. 4—6. In the Indian ocean and the South Pacific; by QUOY and GAIMARD, who first described the animal of this shell, this species was found very numerous at the Island Vanikoro.

*Lima* BRUG. Shell free, subequivalve, inequilateral, oblique, furnished with small auriculæ, subgaping at the side. Hinge edentulous. Animal (*Glaucus* POLI) with mantle margined with long annulate cirri and without ocelliferous tentacles. Foot cylindrical, rugose, clavate, sulcated at the apex. (Animals swimming by contraction of the valves.)

Sp. *Lima squamosa, Ostrea Lima* L., POLI *Test. utr. Sicil.* II. Tab. 28, figs. 22—24, BLAINV. *Malac.* Pl. 62, fig. 3, &c. The fossil genus *Plagiostoma* SOWERBY, LAM., contains different species which belong to *Podopsis*, or rather to *Spondylus*. The remaining, according to the remark of DESHAYES, ought to be united with the genus *Lima*, for instance *Plagiostoma giganteum* from the Lias-formation.

Family IV. *Malleacea.* Mantle open, produced posteriorly. Foot conical, sulcate, mostly byssiferous. Ligament internal, often divided and contained in several little pits. Shell lamellose, pearly within, often deformed, undulato-plicate.

We transfer also to this group the genus *Vulsella*, as was done by DESHAYES, who on the other hand removed *Avicula* from it, which genus we with LAMARCK leave in this family. The characters of the group are not yet sufficiently determined, for the animals of these shells are hitherto only imperfectly or not at all known. Some genera exist only in the fossil state.

*Inoceramus* SOWERBY. Shell inequivalve, with points approximate. Hinge straight, incrassate, furnished with a row of foveolæ for the reception of the divided ligament. (Fossil genus.)

Many fossil species, especially from the Chalk-period, are contained in this genus, whilst none from the tertiary formations are known. DESHAYES, as also GOLDFUSS and BRONN, now unite the genera *Catillus* and *Mytiloïdes* of BRONGNIART with this. Compare the article *Inocerame* of DESHAYES, *Dict. univ. d'Hist. nat.* VII. 1846, pp. 53, 54, and BRONN *Leth. geogn.* pp. 689—696 (first edition).

*Pachymya* SOWERBY?

This genus DESHAYES united formerly with *Catillus*, and now with *Inoceramus;* compare, however, BRONN loc. cit. pp. 696, 697. There is only one species known, also from the chalk-formation: *Pachym. gigas* SOW., BRONN *Leth. geogn.* Tab. 31, figs. 9 *a*, *b*.

*Perna* BRUG. (Species of *Ostrea* L.). Shell flattened, subequivalve, at the anterior side gaping, an aperture emitting the byssus. Hinge straight, linear, edentulous, with parallel furrows receiving the divided ligament.

Sp. *Perna isogonum* LAM., *Ostrea isogonum* L., RUMPH. *Amb. Rariteitk.* Tab. 47, fig. J, CUV. *R. Anim., éd. ill., Moll.* Pl. 81, fig. 1; Ind. Ocean;—*Perna femoralis* LAM. and *P. canina* LAM. are, according to DESHAYES, only varieties of this species.—*Perna ephippium* L., GUÉRIN *Iconogr., Moll.* Pl. 26, fig. 2, &c. Some fossil species also of this genus from the secondary and tertiary formations are known.

*Gervillia* DEFR.

A fossil genus nearly allied to *Perna*, of which species from the oolite- and chalk-period are known.

*Crenatula* LAM. Shell thin, flattened, lamellose, not emarginate for the passage of byssus. Hinge edentulous, linear, crenate at the margin, with semicircular pits receiving the ligament.

Comp. LAMARCK *Ann. du Muséum*, III. pp. 25—31, Pl. 2.

Sp. *Crenatula avicularis* LAM. l. l. Pl. 2, figs. 1, 2, CUV. *R. Ani., éd. ill., Moll.* Pl. 81, fig. 2; in the seas surrounding the South American coasts.

*Vulsella* LAM. Shell irregular, elongate, thin, subequivalve, free. Hinge in both valves furnished with a tubercle cut out with a conical pit for receiving the ligament.

Sp. *Vulsella linguatula* LAM., *Mya vulsella* L., RUMPH. *Amb. Rariteitk.* Tab. 46, fig. A, BLAINV. *Malacol.* Pl. 62, fig. 5, from the Indian ocean, &c. Some species are met with amongst corals, others in sponges. One species from the tertiary formation is known (*Vulsella deperdita* LAM., from the *calcaire grossier*), and a few from the chalk-period.

*Malleus* LAM. Shell subequivalve, rude, often undulate, deformed, elongate, flattened, auriculate, emarginate anteriorly for the passage of byssus. Straight, triangular, sinus between the two valves; points small, divaricate. Hinge edentulous; cardinal fossula oblongo-conical, receiving the ligament.

Sp. *Malleus vulgaris* LAM., *Ostrea malleus* L., RUMPH. *Amb. Rariteitk.* Tab. 47, fig. H.; D'ARGENVILLE *Conchyliologie*, 1757, 4to, Pl. 19, fig. A, BLAINV. *Malac.* Pl. 63, fig. 4; this shell, commonly called the *Polish Hammer*, is found in the East-Indian Ocean. On account of its rarity in collections, *Malleus albus* LAM., CHEMNITZ *Conchyl.* Tab. 206, from the South Sea, may be noticed.

*Avicula* BRUG., DESHAYES. Shell subequivalve or inequivalve, often squamose externally. Hinge edentulous or with one or two small teeth. Area oblique, submarginal, sometimes subindistinct for the internal ligament. Internal surface of valves pearly. Animal compressed, with mantle open, the margin incrassate, cirriferous. Foot conical, vermiform, with byssus thick, the filaments sometimes coalesced.

Sub-genus: *Avicula* LAM. Shell oval, oblique, with ears large. A cardinal tooth in both valves beneath the points.

Sp. *Avicula semisagitta* LAM., *Mytilus Hirundo* L. in part, BLAINV. *Malac.* Pl. 63, fig. 8;—*Avic. Tarentina* LAM., POLI *Testac. utr. Sic.* Tab. 32, figs. 17—21, &c. Fossil species also from the *Muschel-kalk* and other formations are known.

*Meleagrina* LAM. Shell suborbicular, with ears not produced and hinge edentulous.

Sp. *Avicula margaritifera, Mytilus margaritiferus* L., RUMPH. *Amb. Rariteitk.* Tab. 47, figs. F, G; D'ARGENV. Pl. 20, fig. A, BLAINV. *Malac.* Pl.

25 bis, fig. 7, Cuv. *R. Ani., éd. ill., Moll.* Pl. 85, fig. 1; the *pearl-shell.* The shell is sometimes four-cornered, with round margin, greenish-brown striped with white spots, nacreous within, yellow or blueish white. This conchifer produces the finest pearls, and is found in the Persian gulf and in the Indian ocean at Ceylon and Borneo, in the straits of Malacca, &c. The largest pearls are found in the deepest places, as in the Persian gulf near the island Kharrak, where they lie on very deep banks. The Persian pearls are hard, and consequently more esteemed than those of Ceylon, which are often subject to desquamation.

B. *Dimyaria.* Two muscular impressions, mostly remote, sometimes approximate. Ligament of valves external in most.

Family V. *Mytilacea.* Mantle cloven anteriorly. Foot conical or tongue-shaped, byssiferous. Two muscular impressions in each valve remote. Anterior adductor muscle often very small.

*Pinna* L. Shell fragile, thin, often imbricato-squamose, elongate, triangular, angustate towards the points. Hinge edentulous; ligament marginal. Animal (*Chimœra* Poli) with foot vermicular, subulate, transversely rugose, delivering at its base the byssus of long, dense, silken filaments. Anterior adductor muscle near the apices, posterior larger, subcentral. A conical contractile appendage at the posterior part of mantle (*trachea* Poli).

The shells are large, triangular, thin, and very small at the point; along each shell there runs lengthwise a keel-shaped eminence sometimes feeble, for each is formed of two surfaces that meet at an obtuse angle. The animal penetrates the sand with the point of the shell, and fastens itself above it by the byssus to other objects. The silky byssus-threads of species from the Mediterranean are used in Calabria and Sicily as guards for gloves, stockings, purses, &c.

Sp. *Pinna nobilis* L., *Pinna muricata* Poli, *Testacea utr. Sic.* Tab. 34, fig. 1, Blainv. *Malac.* Pl. 64, fig. 1;—*Pinna rotundata* L. (and *P. squamosa* Gmell., Lam.), Lister Tab. 374, fig. 215, *Encycl. méth., Vers.* Pl. 200, fig. 2, &c. Many fossil species of this genus from the secondary, and some from the tertiary formations are known; to the last belongs *Pinna margaritacea* Lam., *Ann. du Mus.* IX. Pl. 17, fig. 3, from the *calcaire grossier.*

*Mytilus* L. (in part), Brug. Shell elongate, not squamose, rather smooth, equivalve, with points placed forward, hinge edentulous or with two teeth obsolete. Ligament dorsal, linear, received in a narrow, elongate, marginal sinus. Two muscular impressions, the anterior very small. Animal (*Callitriche* Poli) with foot lingulate, canaliculate, byssiferous, the mantle concrete posteriorly

to form a small anal tentaculiferous canal. Labial palps four, elongate, lanceolate.

*Mytilus* LAM. Points terminal.

Sp. *Mytilus edulis* L., BASTER *Natuurk. Uitsp.* I. 117—127, Tab. XI. figs. 9—11, CUV. *R. Ani., éd. ill., Mollusq.* Pl. 89, *mussel.* The shell is elongate and, after the epidermis has been removed, purplish-blue. This species is found in the North Sea and the Mediterranean. Mussels grow quickly, and are already edible in the second year. Sometimes they are injurious, and in the spring with us they are less pleasant to the taste; as experience in Zealand has taught, they are best from July to January. Some constitutions cannot endure mussels, and this has in part contributed to give these conchifers a bad name, as though they were sometimes poisonous. The eggs are not taken up by the gills, as in *Anodonta* and *Unio*, but by the mantle. Compare for the anatomy of the mussel A. DE HEIDE *Anatome Mytili.* Amstelod. 1683, 8vo, POLI *Test. utr. Sicil.* II. pp. 197—207, Tab. 31, G. R. TREVIRANUS *Zeitschr. f. Physiol.* I. 1824, s. 41—47, Tab. V. figs. 26—29. For the other species of this genus, see LAMARCK *Hist. nat. des Ani. s. v.* and DESHAYES *Encycl. méth., Vers.* II. pp. 557 and foll.

*Modiola* LAM. Points sublateral.

Sp. *Modiola tulipa* LAM., *Encycl. méth., Vers.* Pl. 221, fig. 1, from the gulf of Mexico, &c.

There are elongated species, that penetrate into stones, of which CUVIER forms the sub-genus *Lithodomus.* Sp. *Mytilus lithophagus* L., *Mod. lithophaga* LAM., BLAINV. *Malac.* Pl. 64, fig. 4.[1]

*Tichogonia* ROSSM., *Dreissena* V. BENEDEN. Shell elongate, trigonal, inflated posteriorly, flat or subconcave anteriorly. Points terminal; internal septum near the points. Mantle anteriorly concrete, excised for foot. Anal trachea distinct.

Sp. *Tichogonia Chemnitzii* ROSSMAESSLER, *Mytilus polymorphus fluviatilis* PALL., *Mytilus Hagenii* V. BAER, DESHAYES *Conchyl.* Pl. 37, figs. 9—11, &c. PALLAS first discovered this species in the Wolga; in Holland it was first met with in the sea of Haarlem by H. W. WAARDENBURG, who described it under the name of *Mytilus lineatus* LAM., with which, however, it does not agree (*Ann. Acad. Lugd. Bat.* 1826, 1827, *Comment. de Moll. indig.*); it occurs also round Leyden in the Cingels and elsewhere. VAN BENEDEN has given a further account of this animal in *Ann. des Sc. nat.*,

[1] In the columns, which are the remains of the temple of Serapis in the gulf of Baiæ, an entire segment is seen, which is perforated by these animals, about 22 feet above the surface of the sea; see POLI *Test. utr. Sic.* II. p. 216; recent geology has borrowed a proof from this of the depression and upheaving of the ground from which so many phænomena receive their explanation. Compare the well-known work of LYELL *Principles of Geology.*

sec. Série, III. 1835, pp. 193—213, Pl. VIII.; CANTRAINE, who places this genus, on account of the mantle for the most part united, not in this family, but in *Byssomya*, names it *Mytilina*. *Ann. des Sc. nat.*, sec. Série, VII. pp. 302—312. It agrees, however, very closely with *Mytilus*, as well in the shell as in the animal.

Family VI. *Arcacea*. Mantle cloven anteriorly, not produced into a trachea. Foot large, in some serving for creeping, in others furnished with byssus horny, lamellose, not divided into filaments. Branchiæ composed of loose filaments. Shell regular, with points remote. Hinge with numerous teeth arranged in a row. Two muscular impressions remote.

*Arca* L. (in part). Hinge linear, straight. Shell transverse, inequilateral, with points distant, a large area intervening. Animal (*Daphne* POLI) with foot compressed, cloven longitudinally, mostly adhering by means of lamellose, horny byssus to marine bodies.

Sp. *Arca Noæ* L., RUMPH. *Amb. Rariteitk.* Tab. 44, fig. P, *Encycl. méth., Vers.* Pl. 303, BLAINV. *Malacol.* Pl. 65, fig. 2; in the Mediterranean and the Atlantic; the *Noah's Arc;* the boat-like form occasioned the generic name.—*Arca tortuosa* L., RUMPH. l. l. Tab. 47, fig. K, *Encycl. méth., Vers.* Pl. 305, fig. 1, BLAINV. *Malac.* Pl. 65 bis, fig. 1, from the Indian Ocean, &c. A very numerous genus, of which also fossil species occur, some in secondary, but the most in tertiary formations.

*Cucullæa* LAM. Shell ventricose. Hinge terminated at each end by ribs exsert, parallel to the margin, various in number.

Sp. *Arca cucullus* GMEL., *Cucullæa auriculifera* LAM., BLAINV. *Malac.* Pl. 65, fig. 4; from the Indian Ocean. The fossil species of this small group are the more numerous, since amongst the animal world now living, only this single one is known.

*Pectunculus* LAM. (Species of *Arca* L.). Shell orbicular, thick, shut. Hinge arcuate, with teeth oblique, the median obsolete. Animal (*Axinæa* POLI) with foot hatchet-shaped, serving for creeping, very large, compressed, not byssiferous; heart single.

Sp. *Pectunculus pilosus* LAM., *Arca pilosa* L. (and *glycimeris* in part), BONANNI *Recreat. Mentis et Oculi*, Romæ, 1684, fig. 80, POLI *Test. utr. Sic.* Tab. 26, figs. 2, 3, GUÉRIN *Iconogr., Moll.* Pl. 27, fig. 6, DESHAYES *Conchyl.* Pl. 34, figs. 23, 24[1];—*Pect. glycimeris* LAM., DESH. l. l. figs. 21, 22,

[1] The shells of this species are used by the Sicilians, according to the account of POLI, for making cameos.

&c. Many extinct fossil species also of this genus occur, whilst the newer tertiary formations contain also the named living species in a fossil state. See on these fossil species LAMARCK *Ann. du Mus.* VI. pp. 215—217, IX. Pl. 18, figs. 6—9, and DESHAYES *Descr. des Coquilles foss. des environs de Paris.*

Family VII. *Trigoniacea.* Mantle cloven anteriorly, trachea none. Foot not byssiferous, serving for creeping. Shell equivalve, inequilateral, hinge with several teeth, arranged in two rows diverging from the point. Points contiguous, or slightly remote. Two muscular impressions remote; internal surface of valves often pearly.

*Nucula* LAM. Shell transverse, with points contiguous. Hinge linear, broken, interrupted by a pit for receiving the internal ligament, with numerous teeth.

Sp. *Nucula margaritacea* LAM., *Arca nucleus* L., BLAINV. *Malac.* Pl. 65, fig. 5, DESHAYES *Conchyl.* Pl. 34, figs. 11—13; in the North Sea and Mediterranean. This species also occurs fossil. The foot of these conchifers resembles that of *Pectunculus.* This genus, which has filiform gills, might be left in the preceding family. Of late years many species have become known, especially through the English voyager CUMMING. They are all small conchifers.

*Trigonia* BRUG. Shell trigonal, sometimes suborbicular. Cardinal teeth oblong, grooved. Ligament external, marginal. Foot elongate, geniculate, with the apical portion received in a groove on the inferior surface of the basal portion.

Sp. *Trigonia pectinata* LAM., *Trigon. margaritacea, Ann. du Mus.* IV. pp. 355—357, Pl. 67, fig. 1, BLAINVILLE *Malac.* Pl. 70, fig. 1; in the S. Pacific. This is the only species now living which is known of this genus, of which numerous fossil species occur, partly in the older secondary formations. Here belongs also the genus *Myophoria* BRONN *Leth. geogn.* I. pp. 168—174, from the *Muschel-kalk.* Especially, however, are the species of *Trigonia* numerous in the Jura- and Chalk-formations. Comp. also AGASSIZ *Etudes critiques sur les Mollusques, 1re livraison,* Neufchatel, 1840, 4to.

Family VIII. *Naïadea.* Mantle mostly cloven, sometimes concrete posteriorly and produced into two short tracheæ. Foot compressed, byssus none. Four oval buccal tentacles. Shell transverse, inequilateral, pearly within. Two muscular impressions distinct, remote. Ligament external.

This family contains fresh-water conchifers. LINNÆUS united the species known to him partly with *Mya,* partly with *Mytilus.* They might perhaps be all united in one large genus *Unio.*

Phalanx I. *Shell regular, free, with points approximate.*

*Unio* BRUG. Animal (*Limnæa* POLI) with mantle cloven, concrete posteriorly by a commissure about the anus, surrounding the anus with a trachea like an aperture. Posterior margin of each lobe of mantle furnished with cirri or tentacles. Branchiæ of each side coalesced behind the foot. Shell thick, pearly within, with points most frequently decorticate. Hinge mostly with two teeth in each valve, the anterior thick, obliquely striated, the posterior compressed like a lamella, elongate, sometimes obsolete. (Teeth of left valve bipartite by a groove for receiving the teeth of the opposite valve.)

This genus is very numerous in species, especially in North America. The knowledge of these species is attended with great difficulties, since the naturalists who have described them have dispersed their descriptions, partly in Magazines, which are entirely unknown in Europe, and at the same time have paid little regard to the contemporary or previous labours of one another. We mention here only, as the most accessible, the papers of RAFINESQUE (*Ann. des Sc. physiques de* MM. BORY DE ST. VINCENT *et* DRAPIEZ, V. pp. 287 and foll.), J. LEA (*Americ. Philos. Transact., new Series*, III. Philadelphia, 1828, pp. 259—263; III. Pt. 2, 1830, pp. 403—457, IV. Pt. 1, pp. 63—121), and the memoir of DE FÉRUSSAC, in great part bibliographical, in GUÉRIN'S *Magasin de Zoologie*, 1835, in which the descriptions of TH. SAY and others are cited.

The form of the numerous shells of this class is very different. For some of the forms distinct genera have been adopted. Thus LAMARCK distinguishes the species with a triangular shell and transverse striæ on the teeth of the hinge, by the name of *Castalia* (Sp. *Castalia ambigua* LAM., BLAINV., *Malacol.* Pl. 67, fig. 4, from S. America). The species that have an oblique shell, and at the posterior margin present a large, flat, triangular prolongation, he unites under the genus *Hyria*. (Sp. *Unio syrmatophorus* O. FABR.[1], *Hyria avicularis* LAM., *Mya syrmatophora* GRONOV. *Zoophylac.* Tab. XVIII. fig. 1, *Unio corrugatus* BLAINV., *Malacol.* Pl. 67, fig. 1;—*Hyria corrugata* LAM., *Encycl. méth., Vers.* Pl. 247, fig. 2.) The other species LAMARCK leaves together under the genus *Unio*. But besides *Castalia* and *Hyria* great varieties of form are found, of which sub-genera might be made, as *Unio orbiculatus* HILDR. or *Unio subrotundus* RAFIN. of a round form[2], *Unio arcæformis* LEA, with a flat broad surface behind the points, &c. In European species the shell is usually less different in form, elongate, forwards round and obtuse, backwards pointed and prolonged.

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[1] O. FABRICIUS *in Kongel. Danske Videnskab. Selskabs Naturvidensk. Afhandlinger*, I. 1824, pp. 55—61.

[2] See, for example, *Unio verrucosa* VALENC., in HUMBOLDT *et* BONPLAND *Recueil d'Observ. de Zool. et d'Anat. comp.* II. Pl. 53, fig. 2.

Sp. *Unio pictorum* LAM., *Mya pictorum* L., STURM *Faun. Germ.* VI. Heft 2, Tab. *a*, *Unio rostrata* PFEIFFER *Deutsche Land- und Wasserschn.* I. Tab. V. fig. 8;—*Unio margaritiferus* RETZ., NILSON, *Mya margaritifera* L., *Unio sinuata* LAM. (and *Unio elongata* LAM.), SCHROETER *Geschichte der Flussconchyl.* 1779, 4to, Tab. IV. fig. 1, PFEIFFER l. l. Tab. V. fig. 11, &c. This species, like the *Meleagrina*, produces fine pearls (see above, p. 688).—As a very large species from N. America we note: *Unio undulatus* SAY, *Unio Peruviana* LAM., *Encycl. méth., Vers.* Pl. 248, fig. 7, VALENCIENNES in HUMBOLDT *et* BONP. *Obs. de Zool. et d'Anat. comp.* II. p. 229, Pl. 54, fig. 3.

*Anodonta* BRUG. The inhabitant of the shell (*Limnæa* POLI) of the same form as the animal of the preceding genus. Shell mostly thin, transverse, elongate posteriorly, rotundato-truncate anteriorly. Cardinal margin edentulous, linear.

*River-mussel.* This genus differs from the preceding in the greater thinness of the shell, and especially by the absence of hinge, but the animal is entirely the same as in the genus *Unio*, with which too DESHAYES unites it. In the shell also *Unio depressa* V. MUEHLFIELD (PFEIFFER l. l. II. s. 32, 33, Tab. VIII. figs. 3, 4) forms the transition to *Anodonta*. The species of *Anodonta* are much less numerous, and exhibit fewer varieties in the form of the shell, than those of *Unio*.

Sp. *Anodonta cygnea* LAM., *Mytilus cygneus* L., BLAINV. *Malac.* Pl. 66, fig. 1, PFEIFFER l. l. I. Tab. VI. fig. 4, (on account of the coalescence or growing together of the shells on the dorsal side above the ligament, LEA forms of this species and some others, the genus *Symphynota;* such a connexion also occurs in certain species of *Unio*); *Anod. anatina* LAM., *Mytilus anatinus* L., PFEIFFER Tab. VI. fig. 2, &c.

Fossil species both of *Unio* and *Anodonta* occur in the coal-formation. In the Oolite and Lias shells are found which were formerly referred to *Unio*, but now constitute the genus *Cardinia* of AGASSIZ, *Pachyodon* STUTCHBURY (*Unio hybrida, Unio concinna* SOWERBY, &c.). See STUTCHBURY *Annals and Magaz. of Nat. Hist.* VIII. 1842, pp. 481—485.

*Iridina* LAM. Animal with lobes of mantle concrete posteriorly and furnished with two short tracheæ. Shell transverse, elongate, with hinge edentulous, linear, sometimes crenate.

Sp. *Iridina exotica* LAM., *Le mutel* ADANSON, *Hist. nat. du Sénégal, Coquillages*, Pl. 17, fig. 21, BLAINV. *Malac.* Pl. 66, fig. 3, in West Africa and in the Nile; the animal is described and figured by DESHAYES, *Mém. de la Soc. d'Hist. nat. de Paris*, III. 1827, pp. 1—16, Pl. 1;—*Irid. rubens* DESH., *Anatina rubens* LAM., *Encycl. méth., Vers.* Pl. 201, fig. 1.

Phalanx II. *Shell affixed, irregular.*

*Etheria* LAM. (*Ætheria*). Mantle cloven, with margin cirriferous. Four tentacles round the mouth oblong, rotundate. Liga-

ment external, penetrating partly internally into a groove. Hinge callous, edentulous.

LAMARCK, who first made this genus known, thought that it was found in the sea. It was placed in the neighbourhood of the Oysters, from which, however, the shell differs by the two muscular impressions. Since that time these conchifers were found in the Nile by the traveller CAILLAUD. The animal was afterwards described and figured by RANG and QUOY. It agrees, as RANG remarks, with that of *Unio* and *Anodonta*, so that in fact the *Etheriæ* might be shortly characterised as irregular *Anodonta* with one of the two shells attached.

Comp. LAMARCK *Ann. du Muséum*, X. pp. 398—408, Pl. 29—32; FÉRUSSAC *Notice s. l. Éthéries trouvées dans le Nil, Mém. de la Soc. d'Hist. nat. de Paris*, I. 1823, pp. 353—372; RANG et CAILLAUD *Mém. sur le genre Éthérie et descr. de son Animal, Nouv. Ann. du Muséum*, III. 1834, pp. 128—144, QUOY in LESSON *Illustr. de Zoologie*, Pl. 58, 59 (1835).

Sp. *Etheria Lamarckii* FÉRUSS., *Eth. elliptica* LAM. (and *Eth. trigonula* ejusd.), *Ann. du Mus.* X. Pl. 29, 30, fig. 1, BLAINV. *Malac.* Pl. 70 bis, fig. 2, &c., GUÉRIN *Iconogr., Mollusq.* Pl. 26, fig. 8.

All the known species live in fresh water in Africa, and would seem, with *Iridina*, to represent the *Uniones* so numerous in America, which are not abundant in Africa.

Family IX. *Carditacea*. Mantle cloven. Foot compressed, sulcate, not byssiferous. Tentacles around the mouth divided into several lobes. Shell regular, free, inequilateral, equivalve. Two muscular impressions remote. Teeth of hinge mostly two, in some a single tooth, the anterior being obsolete.

*Cardita* BRUG. (exclusive of species), DESHAYES (*Cardita* and *Venericardia* LAM.). Shell suborbicular, transverse or oblique, often costate longitudinally.

An historical review of the genus *Cardita*, and of the modifications it has undergone, was given by DESHAYES *Encycl. méth., Vers.* II. 1830, pp. 194—196. All the species now living are marine, mostly small or only of moderate size. The fossil species are numerous, especially in the *calcaire grossier*, as *Cardita imbricata, Venericardia imbricata* LAM., LISTER *Hist. Conchylior.* Tab. 497, BLAINV. *Malacol.* Pl. 68, fig. 3, DESHAYES *Conchyliol.* Pl. 31, fig. 6, &c.

Family X. *Chamacea*. Mantle excised with a middle aperture for the foot, and furnished with two distinct foramina in the tentaculate margin (trachea of mantle and trachea of gills), elsewhere

closed. Foot round, geniculate, not byssiferous. Shell irregular, inequivalve, adhering. Two muscular impressions remote.

In all the preceding families of the *Dimyaria* the mantle is entirely open at the anterior part. In the following families the margins of the mantle are united anteriorly. Amongst these the present family is distinguished by its irregular shell, just as the *Ætheriacea* are amongst the preceding families.

*Chama* L. (in part), BRUG. Shell irregular, mostly imbricate or lamellose, with points incurved. Hinge with single oblique tooth in each valve, received in a little pit of the other valve. (Animal, *Psilopus* POLI, comp. characters of family.)

Sp. *Chama Lazarus* L., *Chama damæcornis* LAM., RUMPH. *Amb. Rariteitk.* Tab. 42, fig. 3, D'ARGENVILLE *Conchyl.* Pl. 20, fig. F, CHEMN. *Conchylienkab.* Tab. 51, figs. 507, 508; East Indies;—*Chama macerophylla* CHEMN. l. l. Tab. 52, figs. 514, 515, CUV. *R. Ani., éd. ill., Moll.* Pl. 95, fig. 2, &c. All the species of this family live in the sea.

*Cleidotherus* SOWERBY.

Sp. *Chama albida* LAM., *Cleidotherus chamoïdes* SOW., DESHAYES *Conchyliol.* Pl. 29, figs. 1—5; from the South Sea at New Holland.

*Diceras* LAM. Points large, divaricate, contorted into irregular spires. Cardinal tooth very large, thick, incurved.

A fossil genus, of which two or three species are known from the uppermost oolite and chalk formations.

Sp. *Diceras arietina* LAM., DESH. *Conchyliol.* Pl. 28, figs. 4—6, CUV. *R. Ani., éd. ill., Moll.* Pl. 95, fig. 1; this species was first discovered by DELUC in the chalk strata of Mont Salère, SAUSSURE *Voyages dans les Alpes*, I. Pl. II. figs. 1—4 (éd. 8vo. Neuchatel, 1803, pp. 277—280). Comp. on *Diceras* LAMARCK *Ann. du Mus.* VI. pp. 298—302, and DESHAYES *Dict. class. d'Hist. nat.* V. 1824, pp. 465—467.

Appendix to *Chamacea.*

Family of uncertain position, *Rudista* or *Rudistæ.* Fossils in cretaceous strata.

Superior valve operculiform, small. Inferior affixed, elongate, often divided internally by septa.

The fossil conchifers designated by LAMARCK under the unintelligible name *Rudistes*, with which, however, as DESHAYES remarks,

the genus *Hippurites* (placed by LAMARCK amongst the *Cephalopoda*) should be united (*Ann. des Sc. nat.* v. 1825, p. 205, xv. pp. 258—266) seem, when the genera *Crania* and *Calceola*, belonging to the *Brachiopoda* have been separated from them, to be allied to the *Chamacea;* they had probably, however, an entirely open mantle, like the *Ætheriacea, Ostreacea* &c. (DESHAYES *Encycl. méth., Vers.* III. p. 918). The *Hippurites*, large, elongate, conical shells, resembling in some degree, as to external form, the *horns* of mammals, were first discovered at the foot of the Pyrenees by PICOT LA PEYROUSE. GOLDFUSS, however, and D'ORBIGNY also, is of opinion that these *Rudistæ* belong to the *Brachiopoda* and by no means to the *Lamellibranchiata* (*Ann. des Sc. nat.*, sec. Série, XVIII. 1842, pp. 173—192), in which they now find many supporters.

Genera: *Hippurites* LAM., *Caprina* D'ORBIGNY, *Sphærulites* DESMOUL. (and *Radiolites* LAM.) DESH. (*Birostrites* LAM. a fictitious genus from the internal mould of *Sphærulites.*)

Comp. DESHAYES in LAMARCK *Hist. nat. des Ani. s. vert.*, 2e éd. VII. 1836, pp. 278—292, PICOT DE LA PEYROUSE *De novis quibusd. Orthoceratitum et Ostracitum specieb.* Norimb. 1781, fol.; DESHAYES *Essai sur les Sphérulites* (*Bullet. de la Soc. d'Hist. nat. de Bordeaux*, I. 1827); O. ROLLAND DU ROQUAN, *Description des coquilles fossiles de la famille des Rudistes, qui se trouvent dans le terrain crétacé de Corbières.* Avec planches. Carcassone, 1841, 4to.

Family XI. *Tridacnacea.* Mantle with lobes for the greatest part concrete in the margin, furnished with a superior aperture for the passage of foot, and two small inferior, the anterior anal, the posterior respiratory. Four tentacles round the mouth elongate, acuminate. Foot thick. Ligament external, narrow. Two adductor muscles approximate or confluent; muscular impression single, little distinct. Shell regular, equivalve, free.

CUVIER (*Règne Anim.* II. 1817, p. 475) remarked that in the conchifers of this family there is only a single adductor muscle. Consequently LAMARCK placed the genus *Tridacna* subsequently in the division of the *Monomyaria*, with which, however, it does not agree. From the figures of the animal of *Tridacna mutica* given by QUOY and GAIMARD in the narrative of the voyage of the *Astrolabe* (copied in CUV. *R. Ani., éd. ill., Moll.* Pl. 96, fig. 3) it seems that two muscles are present however, which lie close together, and, although in other species they are confluent and form a single muscle, this is no reason for separating *Tridacna* from those families with which in other respects this genus has most agreement.

*Tridacna* BRUG. (Species of *Chama* L.). Shell transverse, inequilateral. Points approximate. Hinge with two teeth, placed behind the points under the ligament; the posterior in the right valve bipartite, a groove receiving the posterior tooth of the left valve.

*Hippopus* LAM., *lunula* closed. Foot not byssiferous.

Sp. *Tridacna hippopus* BLAINV., *Chama hippopus* L., *Hippopus maculatus* LAM., RUMPH. *Amb. Rariteitk.* Tab. 43, fig. C, BLAINV. *Malacol.* Pl. 68, fig. 2, GUÉRIN *Iconogr., Mollusq.* Pl. 29, fig. 7; Indian Ocean.

*Tridacna* LAM. Shell gaping at the *lunula*, with aperture ovate. Foot byssiferous.

Sp. *Tridacna squamosa* LAM., RUMPH. *Amb. Rariteitk.* Tab. 43, fig. A, *Encycl. méth., Vers.* Pl. 236, fig. 1; Indian Ocean;—*Tridacna gigas, Chama gigas* L. (in part), RUMPH. l. l. fig. B, *Encycl. méth., Vers.* Pl. 235, fig. 1. This species also occurs in the Indian Ocean; it is the largest conchifer known. Formerly it was the custom to ornament gardens with them as basins of fountains; in churches these shells sometimes serve for holding the holy-water, as two very large ones may be seen in *St Sulpice* at Paris; hence the derivation of the French name *bénitier* for this species of shell. LINNÆUS records a shell of this kind in the *Museum Ludovicæ Ulricæ*, that weighs 532 pounds.—In *Tridacna* the opening of the *lunula* in older individuals is smaller, so that the difference between *Hippopus* and *Tridacna* is not very essential.

Family XII. *Cardiacea.* Mantle with lobes concrete posteriorly, open anteriorly for the passage of foot; two very short tracheæ distinct, foraminiform, with margin girdled by cirri. Foot large, falciform, not byssiferous. Ligament external. Shell regular, equivalve, free. Hinge with two teeth under the point, receiving each other by mutual insertion, and one or two lateral. Two muscular impressions remote.

*Cardium* L. Shell subequilateral, shorter posteriorly, more gibbous anteriorly, mostly furnished with longitudinal ribs. Four teeth in each valve; with two oblique under the points, receiving each other crosswise by mutual insertion, and two lateral remote, compressed. Animal (*Cerastes* POLI) with foot falciform, very long, serving for jumping.

Sp. *Cardium edule* L., BLAINV. *Malacol.* Pl. 70 bis, fig. 3, BASTER *Natuurk. Uitsp.* II. bl. 76—78, Tab. VIII. figs. 1—4, POLI *Test. utr. Sic.* I. Tab. XVII. figs. 13—15; on the shore in the North and Mediter. Seas; this bivalve, like some other species of this genus, is used for food; the common name in Zealand is *kokhaan.*

*Cardium isocardia* L., RUMPH. *Amb. Rariteitk.* Tab. 48, fig. 9, CHEMN. *Conchyl.* Tab. 17, figs. 174—176, &c.

*Hemicardium* KLEIN, SPENGLER, CUV. Valves compressed, a keel dividing the anterior from the posterior plane.

Sp. *Cardium hemicardium* L., RUMPH. *Amb. Rariteitk.* Tab. 44, fig. H, BLAINV. *Malac.* Pl. 70 bis, fig. 4;—*Cardium cardissa* L., LAM., RUMPH. l. l. Tab. 42, fig. E, &c.

Of the genus *Cardium* SPENGLER has given a monograph, *Skrivter af naturhist. Selskabet*, v. 1. 1799, pp. 1—60, Tab. 1.

The fossil species of *Cardium* are uncommonly numerous, they occur especially in tertiary formations.

*Isocardia* LAM. Shell cordate, with points involute spirally. Two cardinal teeth under the points, compressed, entering; a single lateral tooth posterior, elongate. Animal (*Glossus* POLI) with foot compressed and tentacles of mouth elongate, acuminate.

Sp. *Isocardia cor, Chama Cor* L., BLAINV. *Malac.* Pl. 69, fig. 2, POLI *Testac. utr. Sic.* II. Tab. XXIII. figs. 1, 2 (I. Tab. XV. figs. 34—36 animal); Mediterranean, &c.; also fossil. Much more numerous are the extinct species of this form, which for the most part occur in secondary formations.

*Opis* DEFRANCE. Fossil genus. Is this its place?

Comp. DESHAYES in LAMARCK *Hist. n. d. Ani. s. v.* VI. pp. 519, 520.

*Cypricardia* LAM. Shell inequilateral, elongate posteriorly, oblique or transverse. Three teeth under the points; lateral tooth single, posterior, compressed, acute.

Sp. *Cypricardia oblonga* DESH., *Chama oblonga* L., *Cypric. guinaica* LAM., BLAINV. *Malac.* Pl. 65 bis, fig. 6, DESHAYES *Conchyliol.* Pl. 24, figs. 8, 9, &c.;—Here belong also petrified species from the oolite and chalk formations.

Family XIII. *Veneracea.* Mantle with lobes fimbriated at the margin, concrete posteriorly, open anteriorly for the passage of large, compressed, acute foot; two tracheæ moderate, often coalesced at the base. Ligament external, short. Shell equivalve, free, regular, shut. Mostly three cardinal teeth, diverging obliquely from the point; lateral tooth in some single, posterior, in most none.

*Astarte* SOWERBY, *Crassina* LAM. Cardinal teeth two, divergent. Impression of mantle simple. Shell transversely rugose or

striated, inequilateral, anteriorly truncato-rotundate, orbiculari-trigonal or oblique, incrassated towards the points.

*Astarte dannmoniensis* Sow., *Crassina dannmoniensis* Lam., *Venus crassatella* Blainv. *Malac.* Pl. 75, fig. 7. The fossil species are numerous in the later secondary, and in the tertiary formations. Comp. De La Jonkaire *Note sur le genre Astarte, Mémoires de la Soc. d'Hist. nat. de Paris,* I. 1823, pp. 127—131, Pl. VI.

*Venus* L. (exclusive of species). Cardinal teeth in some three in each valve, in others four in left valve. Lateral tooth none. Impression of mantle below the posterior muscular impression deeply sinuate. (Animal *Callista* Poli.)

a) *Cardinal teeth four in left valve, with fourth elongate, situated under lunula, compressed, received in a foveola of right valve.*

*Cytherea* Lam.

*Venus lusoria, Cyth. lusoria* Lam., *Venus chione* L. (in part), Rumph. *Amb. Rariteitk.* Tab. XLII. fig. G, *Encycl. méth., Vers.* Pl. 270, fig. 1. The Chinese and Japanese cover the inside of these shells with gold and colours, and use them in a certain game.—*Venus Dione* L., Rumph. *Amb. Rariteitk.* Tab. XLVIII. fig. 4, *Encycl. méth., Vers.* Pl. 275, fig. 1, Houttuyn *Nat. Hist.* I. 15e Stuk, Pl. 117, fig. 6; East Ind. Seas. This species is described by Linnæus in detail and metaphorically, *Syst. nat.*, ed. 12, I. p. 1129, &c.

b) *Cardinal teeth three in each valve, approximate.*

*Venus* Lam.

Sp. *Venus plicata* Gm., Lam. (*Venus Dysera* L. in part), D'Argenv. *Conchyl.* Tab. 21, fig. K, *Encycl. méth., Vers.* Pl. 275, fig. 3; *Venus papilionacea* Lam. (*Venus rotundata* L.), Cuv. *R. Ani., éd. ill., Moll.* Pl. 104, fig. 4, &c.[1]

*Cyprina* Lam. Shell obliquely cordate, thick. Hinge with three unequal teeth, and lateral tooth remote, posterior, situated under the fissure. Impression of mantle rotundate, entire. (Animal with tracheæ short, scarcely porrect beyond the margin of shell.)

Sp. *Cyprina islandica* Lam., *Venus islandica* L., Muell. *Zool. Danic.* Tab. 28, Blainv. *Malac.* Pl. 70 bis, fig. 5, Cuv. *R. Ani., éd. ill., Moll.* Pl. 102,

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[1] The species belonging to the genus *Venus* (*Venus* and *Cytherea* Lam.) are so numerous, that they make up nearly ⅓ of all the known *lamellibranchiata*, so that this genus much surpasses the genera *Tellina, Cardium, Arca, Ostrea* and *Pecten* so rich in species.

fig. 3. The *Venus islandica* of BROCCHI (and *Cyprina gigas* LAM.) a fossil species from the *calcaire grossier* and other tertiary strata, does not belong to this genus, but to the preceding, *Venus Brocchii* DESH., BRONN *Leth.* Tab. 38, fig. 1.

Family XIV. *Cycladea.* Mantle concrete posteriorly, furnished with two tracheæ. Ligament internal. Foot large, not byssiferous. Shell equivalve, free, gibbous or ventricose. Hinge with teeth under the point various, sometimes obsolete, and with lateral teeth gone. Two muscular impressions remote.

This small family contains conchifers that live in rivers and in fresh-water lakes, like the *Naïdea*, from which it sufficiently differs, although *Iridina* (see above, p. 736), on account of the united mantle and the two tracheæ might be brought to it. The present family is nearly allied to the preceding, whose place they represent in fresh water.

*Glauconome* GRAY. Cardinal teeth three, with middle one larger, often bifid. Shell elongate, transverse, with points eroded.

Fresh-water bivalves, which in external appearance almost resemble *Anodonta* or *Unio*. They are all exotic. It seems that some fossil fresh-water shells, which previously had been referred to the genus *Venus*, find their true place here.

*Galathea* BRUG., LAM., *Potamophila* SOW. Shell trigonal, subequilateral. Teeth under the point two in right valve, with a small triangular median pit receiving the third intermediate tooth of left valve. Ligament prominent, turgid. Animal with two tracheæ, not concrete, and foot oblong, compressed.

Sp. *Galathea radiata* LAM. (*Venus subviridis* and *Venus hermaphrodita* GMEL.), LISTER *Conchyl.* Tab. 158, fig. 13, *Encycl. méth., Vers.* Pl. 250, fig. 1, LAMARCK *Ann. du Mus.* v. p. 430, Pl. 28, SANDER RANG *Notice sur la Galathée, Ann. des Sc. nat.* Tom. XXV. 1832, pp. 152—164, Pl. v. In the rivers of W. Africa; the description of RANG first made the animal known, the shell alone of this species having been previously known, which some writers stated to be from Ceylon.

*Cyrena* LAM. Shell thick, ventricose, corticate, with points eroded or decorticate. Hinge with three teeth in each valve. (Animal with two tracheæ separate from the base throughout.)

Sp. *Cyrena Zeylonica* LAM., BLAINV. *Malacol.* Pl. 73, fig. 2; a larger variety of this species occurs at Java, s. e. A. MOUSSON, *Die Land- und Süsswasser-Mollusken von Java.* Zurich, 1849, 8vo, Taf. XIII. All the species of this genus are exotic.

*Cyclas* BRUG. (in part), LAM. Shell ovato-globose, thin, tumid at the points. Hinge with teeth very small, sometimes subnull.

Sp. *Cyclas cornea* LAM., *Tellina cornea* L., BLAINV. *Malacol.* Pl. 73, fig. 1, PFEIFFER *Systemat. Anordn. u. Beschr. deutscher Land- und Wasserschn.* Cassel, 1821, 4to, Tab. v. figs. 1, 2, shell brown-yellow, transparent, blue-white within, 4 or 5‴ large; not rare in the canals of Holland. The species of this genus, which is much allied to the preceding, are especially found in Europe, but some occur also in other parts of the world.—PFEIFFER further distinguishes the genus *Pisidium*, by the absence of long *tracheæ*, which in the animal of these species are short and grown together. Sp. *Cyclas obliqua* LAM., *Cycl. fontinalis* LAM., *Cycl. obtusalis* LAM.

Family XV. *Lucinacea.* Mantle open anteriorly, concrete posteriorly, and furnished with branchial aperture and single anal trachea, or produced into two tracheæ connate from the base throughout. Foot cylindrical, elongate, often vermiform. Ligament external or subinternal concealed between the exsert margins of fissure. Two muscular impressions remote, large, with anterior elongate. Shell free; hinge variable, in some edentulous, in others with two teeth under the point, and one or two lateral teeth.

*Cyrenoïda* JOANNIS, *Cyrenella* DESHAYES. Shell ventricose, corticate. Hinge with two small teeth divergent in right valve, and one tooth bifid in left valve; lateral teeth none. Animal with two tracheæ concrete and four labial palps.

Sp. *Cyrenoïda Dupontia* JOANNIS, GUÉRIN *Magasin de Zool.* 1835, *Mollusq.* Pl. 64. Comp. DESHAYES, ibid. No. 70; Senegal. This genus counts only a few species, all exotic, from fresh water. According to DESHAYES *Cyrenella* is a fresh-water *Lucina*, according to DE JOANNIS, a *Cyrena* without lateral teeth at the hinge of the shell. At all events, this genus is intermediate between this and the preceding family.

*Lucina* BRUG. Shell orbiculate, transversely striated, subequilateral, with points short, acuminate, incurved forwards. Hinge variable. Animal (*Loripes* POLI) with foot very long, vermiform, respiratory trachea foraminiform, anal conical, retractile by invagination.

Sp. *Lucina lactea* LAM., *Tellina lactea* L., *Encycl. méth., Vers.* Pl. 286, fig. 1, POLI *Testac. utr. Sic.* I. Tab. XV. figs. 26—29; hab. Mediterranean;—*Lucina pensylvanica* LAM., *Venus pensylvanica* L., D'ARGENV. *Conchyl.* Tab. 21, fig. N, *Encycl. méth., Vers.* Pl. 284, fig. 1; hab. in the ocean at the coast of N. Amer.; *Lucina divaricata* LAM., *Tellina divaricata* L., POLI l. l. fig. 25, *Encycl. méth., Vers.* Pl. 285, fig. 4, DESHAYES *Conchyl.* Pl. 16, figs. 9—11; hab. in Mediterranean, &c.

*Ungulina* DAUDIN, LAM.

This genus is much allied to *Lucina*, with which DESHAYES unites it. *Ungulina oblonga* LAM., BLAINV. *Malac.* Pl. 73, fig. 6; from the coast of Senegal. Since this animal penetrates stones and corals, the external form of the shell is subject to much variety. See on the animal, of which previously the shell alone was known, DUVERNOY *Ann. des Sc. nat.* sec. Série, Tom. 18, pp. 110—122, Pl. v. B. Comp. DESHAYES ibid. Tom. 19, pp. 5—11.

*Corbis* CUV. Shell transverse, gibbous. Hinge with two teeth under the point, and two lateral.

Sp. *Corbis fimbriata* LAM., *Venus fimbriata* L., D'ARGENV. *Conchyl.* Tab. 21, fig. G, *Encycl. méth., Vers.* Pl. 286, fig. 3, BLAINV. *Malac.* Pl. 72, fig. 4; Indian Sea. This shell is finely striated longitudinally between grooves running parallel to the margin. Hence the French name *la Tricotée* or *la Corbeille*, of which last the generic name *Corbis* is a translation. There are fossil species of this genus which are as finely or even more finely treliced.

Family XVI. *Saxicavina* (or *Lithophaga*). Lobes of mantle as to the greater part concrete, with aperture narrow, anterior, emitting the small foot. Tracheæ two, coalesced at the base, tentaculate at the opening. Shell transverse, inequilateral, posteriorly elongate, gaping. Ligament external. Two muscular impressions remote. Impression of mantle deeply sinuate posteriorly. (Animals living in stones, hence the form of shell often irregular.)

This small family is connected with the genus *Venus* on the one hand, and with *Gastrochæna* on the other; perhaps the genus *Saxicava* might be placed in the last family. They are marine conchifers like all the following families.

*Petricola* LAM. (and *Venerupis* ejusd.) Hinge with two teeth in each valve, sometimes with three. Branchiæ unequal, external smaller.

*Venerupis* LAM. Tracheæ separate at the apex alone. Hinge with three teeth in one valve, sometimes in both.

Sp. *Venerupis irus* LAM., *Donax Irus* L., *Encycl. méth., Vers.* Pl. 262, fig. 4, POLI *Test. utr. Sic.* II. Tab. 19, figs. 25, 26; hab. Mediterranean;—*Vener. perforans* LAM., *Venus perforans* MONTAGU. (PHILIPPI has given a figure of the Mollusc, see WIEGMANN *Archiv f. Naturgesch.* 1845, Tab. VII. figs. 15—18.)

*Petricola* LAM. Tracheæ coalesced at the base, free at the terminal part for nearly half their length. Hinge with two teeth in each valve, or with only a single tooth in one of the valves.

Sp. *Petricola roccellaria* LAM., DESH. *Conchyliol.* Pl. 12, fig. 7, &c. (on the animal of *Petricola* see PHILIPPI l. l. p. 188, Tab. VII. figs. 11—14). Fossil species from the tertiary formations are known.

*Saxicava* FLEURIAU DE BELLEVUE, LAM. (*Hiatella* DAUD., LAM., *Byssomya* CUV.). Shell with tooth obsolete, tuberculiform, or edentulous. Foot very large, often byssiferous.

Sp. *Saxicava pholadis* LAM., *Mytilus pholadis* L., MUELLER *Zool. Danic.* Tab. 87, figs. 1—3 (infer.), BLAINV. *Malacol.* Pl. 80, fig. 5; *Saxicava arctica* PHILIPPI, *Solen minutus* L., LAM., *Mya arctica* L., *Hiatella arctica* LAM., *Encycl. méth., Vers.* Pl. 234, fig. 4, BLAINV. *Malac.* Pl. 80, fig. 6 (named *Rhomboïdis rugos.*), CUV. *R. Ani., Moll.* Pl. 110, fig. 1, &c.

Family XVII. *Tellinacea.* Mantle with lobes concrete posteriorly, margin tentaculiferous. Tracheæ two, separate, often very long. Foot triangular, compressed. Shell transverse, equivalve, inequilateral, with posterior part often shorter. Ligament external. Two muscular impressions remote. Impression of mantle sinuate posteriorly.

That margin of the shell which is ordinarily the longest, is here often the shortest, the hindmost, namely, or that where the ligament is situated. It was an error, therefore, in LAMARCK to suppose that in *Donax* the ligament is displaced, and lies on the *lunula;* it lies, as in all bivalve shells, behind the point.

*Donax* L. Shell transverse, posteriorly obtuse, flat. Cardinal teeth two either in both valves or in left, a single tooth bipartite in right; lateral tooth single or two lateral teeth, subremote, sometimes obsolete. Ligament short. Animal (*Peronæa* POLI) with tracheæ long, distinct, unequal, the inferior longer; cirri at the orifice of anal (superior) trachea simple, at the orifice of branchial trachea ramoso-digitate. Foot large, conspicuous.

Sp. *Donax scortum* L., D'ARGENVILLE *Conchyl.* Pl. 21, fig. L, BLAINV. *Malac.* Pl. 71, fig. 1, DESHAYES *Conchyl.* Pl. 14, figs. 12—15 (*Donax pubescens* L. variety); hab. Indian Ocean;—*Donax trunculus* L., POLI *Testac. utriusq. Sicil.* II. Tab. 19, figs. 12—20, BLAINV. *Malac.* Pl. 71, fig. 2, &c.

(*Capsa* LAM. Lateral teeth none.) Sp. *Donax brasiliensis* BLAINV., *Capsa brasiliensis* LAM., *Encycl. méth., Vers.* Pl. 261, fig. 10, BLAINV. *Malac.* Pl. 71, fig. 3.

*Psammobia* LAM. (and *Sanguinolaria* ejusd.). Shell transverse, subequilateral, subhiant at both ends. Hinge with two teeth, more rarely with single tooth in each valve, lateral teeth none.

Animal (*Peronœa* POLI) with both tracheæ extremely long, subequal, and with margin of mantle as though serrate with acuminate, conical cirri.

*Capsa* BRUG., DESH. (not LAM.) Shell convex. Hinge narrow, with two unequal teeth in each valve. Ligament thick, elongate. Lunula indistinct.

Sp. *Psammobia rugosa* SOWERBY, REEVE, *Sanguinolaria rugosa* LAM., *Venus deflorata* L., CHEMNITZ *Conchyl.* Tab. 9, figs. 79—83, DESHAYES *Conchyl.* Pl. 13, figs. 1—3; this species of shell is met with in the Atlantic, the Red Sea and the Indian Ocean, and is amongst the most generally dispersed species. The animal is still unknown.

*Sanguinolaria* LAM., DESH. Shell flat. Hinge with two unequal teeth. Ligament elongate, flat.

Sp. *Psammobia sanguinolenta* nob., *Solen sanguinolentus* GM., *Sanguinolaria rosea* LAM., CHEMN. *Conchyl.* Tab. 7, fig. 56.

*Psammobia* LAM., DESH. Shell flat. Hinge with two teeth small, diverging or with single tooth. Ligament elongate, gibbous, protuberant.

Sp. *Psammobia vespertina* LAM., *Solen vespertinus* GM., BLAINV. *Malacol.* Pl. 77, fig. 4;—*Psammobia incarnata* DESH. (*Tellina incarnata* L., *Fauna Suec.*), *Psammob. feroensis* LAM. &c. These two species occur also fossil in tertiary formations.

*Tellina* L. (exclusive of some species). Shell thin, mostly transverse, inequilateral, anteriorly shorter, rotundate, posteriorly plicate, with fold running obliquely from the margin towards the points. Hinge narrow, with two teeth or single tooth in each valve; in most two lateral teeth remote. Animal (*Peronœa* POLI) with foot large, lanceolate and margin of mantle cirrate with long unequal tracheæ, hiding deep under the sand.

The species of this genus are numerous, especially in other parts of the world. In most the shell is long and flat, as *Tellina radiata* L., D'ARGENVILLE *Conchyl.* Pl. 22, fig. A, *Encycl. méth., Vers.* Pl. 289, fig. 2, BLAINV. *Malacol.* Pl. 71, fig. 4; sometimes ending behind with a thin elongated part, as in *Tellina rostrata* L., *Tellina Spengleri* GM., LAM. *Encycl., Vers.* Pl. 287, fig. 5.—In others the shell is more round, as *Tellina lingua felis* L., RUMPH. l. l. fig. G, GUÉRIN *Iconogr., Moll.* Pl. 31, fig. 1. In the North Sea is found *Tellina fabula* GMEL., LAM., GRONOV. *Zoophylac.* Tab. 18, fig. 9, *Tellina solidula* SOLAND., LAM. &c.

Comp. on this genus SPENGLER *Skriviter af naturh. Selskabet,* IV. 2. Kjöbenhavn, 1798, pp. 67—121, Tab. 12.

*Tellinides* LAM. Posterior margin of shell without irregular fold.

Sp. *Tellina Timorensis* BLAINV., *Tellinides Timoriensis* LAM., BLAINV. *Malacol.* Pl. 72, fig. 2. (DESHAYES has rejected this sub-genus, calling to mind that some *Tellinæ* by slow degrees conduct to this form.

*Fragilia* DESH. Shell subtrigonal, gibbous, anteriorly rotundate, posteriorly longer. Hinge with two teeth diverging in each valve.

Sp. *Tellina fragilis* L., *Petricola ochroleuca* LAM., POLI *Test. utr. Sic.* I. Tab. XV. figs. 22, 24, DESH. *Conchyliol.* Pl. 12, figs. 13—25. Hab. in Mediterranean.

Family XVIII. *Mactracea.* Mantle open anteriorly, concrete posteriorly, produced into two tracheæ, in some separate, in others coalesced. Foot compressed, triangular. Shell equivalve, free. Ligament internal, received in a pit; in some an external ligament as well as an internal. Two muscular impressions remote. Impression of mantle marked posteriorly with a sinus, in some broad, in others deep, narrower.

*Amphidesma* LAM. (in part), RECLUZ, DESH. Shell rotundate, suborbiculate, thin. Hinge with two teeth in each valve. Ligament double; external short; internal in a pit of hinge oblique, deep, narrow.

Sp. *Amphidesma variegata* LAM., *Encycl. méth., Vers.* Pl. 291, fig. 3; Indian Ocean;—*Amph. solida* GRAY, DESH. *Conchyliol.* Pl. 11, figs. 10—12, South Sea, at the coast of Peru.

*Syndosmya* RECLUZ, DESH. Shell transverse, oval, thin, with anterior side shorter. Hinge with two teeth in right valve, with intermediate foveola receiving the single tooth of left valve. Two lateral teeth. Ligament double; external small, internal received in a spoon-shaped process. Animal with two tracheæ long, separate.

Sp. *Syndosmya alba, Amphidesma Boysii* LAM., DESH. *Conchyl.* Pl. 8 bis, figs. 6—8, &c.

*Trigonella* DA COSTA, DESH. (Species of *Mactra* GMEL., subgenus of *Mactra* CUV., spec. of *Lutraria* LAM.) Shell orbiculato-trigonal, flat, subequilateral, with anterior side shorter, rotundate, posterior subhiant. Hinge narrow, with two small teeth in right

valve, single tooth in left; a triangular pit receiving internal ligament. External ligament small. Animal with tracheæ long, slender, separate, very unequal.

Sp. *Trigonella plana* LOVÉN, *Mactra piperata* GMEL., *Lutraria compressa* LAM., BLAINV. *Malac.* Pl. 77, fig. 2; BASTER *Natuurk. Uitsp.* II. Tab. VIII. figs. 5—7. This species keeps itself deep in the sand on sea-coasts, and also occurs fossil in the Crag-formation.

*Cumingia* SOWERBY.

Sp. *Cumingia tellinoïdes* DESH. *Conchyliol.* Pl. 8 bis, figs. 9—11; all the species exotic.

*Mesodesma* DESH. Shell transverse with anterior side longer, thick, shut. Ligament only internal, received in a narrow, deep pit. Hinge with one or two teeth under the point, and two lateral. Animal with two tracheæ separate (*Peronæa* POLI).

Sp. *Mesodesma Quoyi* DESH., *Conchyl.* Pl. 10, figs. 13, 14;—*Mesodesma cornea* DESH., *Amphidesma donacilla* LAM., POLI *Testac. utr. Sicil.* Tab. XIX. figs. 8—11 (*Mactra cornea*, habitus almost of Donax).

*Gnathodon* GRAY, *Rangia* DESMOULINS.

Sp. *Gnathodon cuneatus* GRAY, DESH. *Conchyl.* Pl. 10, figs. 9—12. Comp. RANG, *Nouv. Ann. du Mus.* III. 1834, pp. 217—230, Pl. 12. This species lives in the brackish water of the great lake *Pontchartrain* in Louisiana.

*Anatinella* SOW.

Sp. *Anatinella Sibbaldii* SOW., *Mya* CHEMN. *Conchyl.* Tab. 3, figs. 17, 18, DESH. *Conchyl.* Pl. 8 bis, figs. 4, 5.

*Mactra* L. Shell transverse, inequilateral, subhiant at both ends. An excavated process under the points in hinge, receiving the internal ligament; cardinal tooth bifid or forked in front of pit for ligament. Animal (*Callista* POLI) with tracheæ coalesced, foot compressed.

Comp. L. SPENGLER *Beskrivelse over det Slaegt Mactra. Skrivter af naturhist. Selskabet*, v. 2. Kjöbenhavn, 1802, pp. 92—128.

*Mactra* LAM. Shell trigonal, tumid at the points. Two lateral compressed teeth in left valve, received between two lamellæ of right valve.

Sp. *Mactra stultorum* L., POLI *Test. utr. Sic.* I. Tab. 18, figs. 10—12, BLAINV. *Malac.* Pl. 73, fig. 5, CUV. *R. Ani., éd. ill., Moll.* Pl. 107, figs. 2, 2*a*; brownish grey, with light radiating striæ, purplish within; very common in

the North Sea and Mediterranean. *Mactra helvacea* CHEMN., LAM., *Mactra glauca* SPENGLER, POLI, l. l. figs. 1—3, SPENGLER l. l. Tab. III. fig. 1; in the Mediterranean. This genus counts very many species from all seas. Some fossil species of it also are known, which occur in the tertiary formations.

*Lutraria* LAM. (in part), DESH. Shell transverse, elongate posteriorly, flattened, lateral teeth none.

Sp. *Mactra lutraria* L., *Lutraria elliptica* LAM., CHEMN. *Conchyl.* Tab. 24, figs. 240, 241, &c. This sub-genus is much less numerous than the preceding. The species cited occur also fossil in tertiary formations.

Family XIX. *Myacea.* Mantle sacciform, with lobes almost entirely conjoined at the margin, perforated anteriorly alone by a small aperture for the transmission of foot. Foot small. Tracheæ mostly coalesced, retractile. Shell mostly gaping. Ligament internal, inserted in a tooth or spoon-shaped process, somewhat prominent at the hinge. Two muscular impressions remote; impression of mantle mostly excised posteriorly by a sinus.

Phalanx I. *Osteodesmacea.* Cochleariform tooth in each valve, receiving the ligament. Mostly a loose calcareous particle (*ossiculum* DESH.) contained in ligament. Two tracheæ often separate.

*Cardilia* DESH. (Is this its place?)

*Note.*—Habitus of *Isocardia.* Spec. *Isocardia semi-sulcata* LAM. and some others; two are fossil from the more recent strata. Comp. DESHAYES in LAMARCK *Hist. nat. des Ani. s. v.* éd. 2, VI. pp. 448—450, and GUÉRIN *Magas. de Zool.* 1844, Pl. 99—101.

*Myochama* STUTCHBURY. Shell affixed, irregular, inequivalve. Animal with short separate tracheæ.

Sp. *Myochama anomioïdes* STUTCHBURY, DESH. *Conchyl.* Pl. 8 bis, figs. 12, 13, &c.

*Thracia* LEACH, DESH. Shell free, inequivalve, transverse, truncated posteriorly, hiant at both ends, with umbones tumid. Ligament double; external small. Animal with two tracheæ short, separate.

Sp. *Thracia convexa* DESH., BLAINV. *Malacol.* Pl. 76, fig. 6, DESH. *Conchyliol.* Pl. 9, figs. 1—6; in the N. Sea, Mediter. &c. There are fossil species of this genus in the Jura- and Chalk-formations, and in the tertiary strata.

*Anatina* LAM. Shell free, subequivalve, transverse, thin, fragile. Impression of mantle sinuate posteriorly. Animal with two tracheæ coalesced.

Sp. *Anatina subrostrata* LAM., *Solen anatinus* L., RUMPH. *Amb. Rariteitk.* Tab. 45, fig. o, BLAINV. *Malac.* Pl. 78, fig. 6, DESH. *Conchyliol.* Pl. 8, figs. 20—23; in the Ind. Ocean, &c. Also of this genus fossil species occur in different secondary and tertiary strata.

On the animal of this genus of conchifers, comp. H. MITFRE *Mém. s. l. genre Anatine*, GUÉRIN *Magas. de Zool.* 1844, *Moll.* Pl. 102—104.

*Periploma* SCHUMACHER, DESH.

*Osteodesma* DESH.

*Lyonsia* TURTON, DESH.

Sp. *Anatina norvegica* SOWERBY, *Amphidesma corbuloïdes* LAM., *Mya norvegica* CHEMN. *Conchyl.* Tab. 170, figs. 1667, 1668, DESH. *Conchyl.* Pl. 8, figs. 12—14.

*Myadora* GRAY.

Phalanx II. *Myacea.* Ligament internal, fixed to a fovea of each valve or to a cochleariform process of one valve and a fovea of the other. Tracheæ coalesced into a fleshy thickened cylinder.

*Pandora* BRUG. Shell inequilateral, thin, inequivalve, right valve flat, left slightly convex. Hinge in flat valve guarded by an exsert tooth, other valve emarginate to receive the tooth. Ligament received in a pit behind the hinge on each side.

Sp. *Pandora rostrata* LAM., *Tellina inæquivalvis* L., BLAINV. *Malacol.* Pl. 78, fig. 5, CUV. *R. Ani., éd. ill., Moll.* Pl. 110, fig. 3; Medit.; this species occurs fossil in the crag-formation of England. There are also two other fossil species from the tertiary formations, and some from the Indian Sea known.

*Corbula* BRUG. Shell inequivalve, with right valve more convex. Cardinal tooth in each valve conical with lateral pit. Ligament inserted in tooth of left valve and in pit of right.

Sp. *Corbula nucleus* LAM., *Mya inæquivalvis* MONTAGU, *Encycl. méth., Vers.* Pl. 220, fig. 4, DESH. *Conchyl.* Pl. 8, figs. 7—9; in the N. Sea and Mediterranean. Within the last few years many species from all seas have become known; the fossil species are even more numerous, and occur some in secondary, but in great part in tertiary strata.

*Ervilia* TURTON. Shell inequivalve. Other characters almost those of *Corbula.*

Comp. RECLUZ in GUÉRIN *Magas. de Zool.* 1844, Pl. 95, 96.

*Note.*—Genus *Neæra* GRAY, related to the *Corbulæ* should, on account of the ossicle of the ligament, be removed to the first phalanx of this family.

*Mya* L. (exclusive of several species). Shell subequivalve, transverse, hiant. Left valve with single cardinal tooth large, prominent within towards the right valve, and received in the fovea of this. Ligament inserted in tooth and cardinal fovea. Impression of mantle emarginate with a deep sinus posteriorly.

Sp. *Mya truncata* L., CHEMN. *Conchyl.* Tab. I. figs. 1, 2, DESH. *Conchyl.* Pl. 8, figs. 1—4; *Mya arenaria* L., BASTER *Natuurk. Uitsp.* II. bl. 72—76, Tab. VII. figs. 1—3, BLAINV. *Malacol.* Pl. 77, fig. 1; on the strand of the N. Sea at Katwijk, Scheveningen, the Swedish coasts, &c.—There are some fossil species of *Mya* in the newer tertiary formations, in which also the two living species mentioned are met with.

Family XX. *Pholadomyacea.* Mantle sacciform, produced posteriorly into two elongate conjoined tracheæ, perforated anteriorly by a narrow aperture, emitting the small foot. Shell hiant at both ends. Ligament external. Two muscular impressions remote.

*Pholadomya* SOWERBY, DESH. Shell thin, transverse, longer posteriorly, obtuse anteriorly. Hinge edentulous, inflected. Impression of mantle excised posteriorly by a deep sinus.

Sp. *Pholadomya candida* SOW., DESH. *Conchyl.* Pl. 4, figs. 4—6; a W. Indian species still extremely rare in collections. The fossil species of this genus, that occur in almost all geological formations, are numerous, most so in the Lias. To these also DESHAYES refers the genera *Lysianassa* MUENSTER, AGASSIZ, and *Platymya* AGASSIZ. Comp. AGASSIZ *Études crit. sur les Mollusques, 2e livraison*, Neufchatel, 1842, &c.

*Ceromya* AGASS., DESH. (and *Greslyia* AGASS.).

Fossil species.

*Glycimeris* LAM., *Cystodaria* DAUDIN. Shell thick, transverse, inequilateral, shorter posteriorly, rounded at both ends. Hinge edentulous. Impression of mantle not excised posteriorly, very distinct, with margin incrassate, undate.

Sp. *Glycimeris Siliqua* LAM., *Mya siliqua* SPENGLER, CHEMN. *Conchyl.* Tab. 198, fig. 1934, BLAINV. *Malac.* Pl. 80, fig. 3; comp. AUDOUIN *Mém. sur l'Animal de la Glycimère, Ann. des Sc. nat.* Tom. 28, 1833, pp. 331—343, Pl. 14, 15. Hitherto the only known species of this genus; on the coasts of Newfoundland.

*Panopœa* MÉN. LA GR. Shell transverse, obtusely rotundate at both ends, longer posteriorly. Hinge callous, with accessory tooth in each valve. Impression of mantle excised posteriorly by a sinus.

Sp. *Panopœa Aldrovandi* MÉNARD, *Mya glycimeris* GMEL., CHEMN. *Conchyl.* Pl. 3, fig. 25, DESH. *Conch.* Pl. 7, fig. 1; in the Medit. Sea. A few other living species of this genus are known; they are large bivalves that in some degree resemble *Mya*. The fossil species occur in the chalk-formation and more numerously in the tertiary, to which *Panopœa Faujasii* MÉNARD belongs, according to DESHAYES merely a variety of *Pan. Aldrovandi*. Comp. MÉNARD DE LA GROYE *Ann. du Mus.* IX. 1807, pp. 131—136, Pl. IX. and VALENCIENNES *Archives du Mus.* I. 1839, pp. 1—33, Pl. 1—6.

Family XXI. *Solenacea*. Mantle sacciform, open anteriorly, with foramen for transmitting foot which is large, mostly truncated at the apex, or terminated by a broad disc. Tracheæ very often conjoined. Shell equivalve, transverse, elongate, gaping at both ends. Ligament external. Muscular impressions remote.

*Solen* L. (exclusive of *Anatina*). Shell inequilateral, longer posteriorly. Hinge with small teeth, two in left valve, one in right received between the opposite teeth, or with single tooth in each valve. Ligament elongate, often protuberant.

Comp. L. SPENGLER *Skrivter af Naturh. Selskabet.* Kjöbenhavn, 1793, III. 2, pp. 81—114.

*Solecurtus* BLAINV. (in part), DESH. Shell oval, rotundate at both ends, subequilateral. Ligament large. Animal (*Hypogæa* POLI) larger than shell, with foot large, lingulate. Tracheæ long, conjoined at base into a wide pipe.

Sp. *Solen strigilatus* L., POLI *Test. utr. Sic.* I. Tab. 12, 13, BLAINV. *Malac.* Pl. 79, fig. 4; in the Mediterranean. The fossil bivalve from the tertiary formation, referred by LAMARCK to *Solecurtus strigulatus* (figured *Ann. du Mus.* XII. Pl. 43, fig. 5) is, according to DESHAYES, a distinct species, *Solecurtus Lamarckii*.

*Solen* DESH. Shell transverse, often very long, with hinge sometimes almost terminal anterior. Ligament elongate. Animal (*Hypogæa* POLI) with two short tracheæ coalesced in most, in some separate, with foot cylindrical, truncated.

*Razor-shell, Manches de Couteau*, &c. The ancient names *Solen, Aulos, Donax* (PLINIUS *Hist. nat.* Lib. XXXII. cap. 11), already indicate the most common form of these shells. They hide in perpendicular holes in the sands of the beach, whilst the tubes are turned upwards. Some species are edible, and are much esteemed by the Italians, as *Solen siliqua*, according

to POLI. The species are numerous, and the fossil, of which some correspond to forms still living, belong principally, though not exclusively, to the tertiary formations.

Sp. *Solen vagina* L., POLI *Test. utr. Sic.* I. Tab. X. figs. 5, 6, BLAINV. *Malacol.* Pl. 79, fig. 2; in this species the hinge lies almost entirely at the anterior end of the shell, and has only one tooth on each valve. In other species it is situated further backward, always however nearer to the anterior than to the posterior extremity of the shell; ex. gr. *Solen legumen* L. from the Medit., *Solen radiatus* L., RUMPH. *Amb. Rariteitk.* Tab. 45, fig. E, from the Indian Ocean, &c.

*Solemya* LAM. (more correctly *Solenomya* MENKE, PHILIPPI). Shell inequilateral, shorter posteriorly, rotundate at both extremities, covered with a periostracon, produced beyond the margins of shell. Hinge callous, edentulous. Animal with trachea short, branchia on each side single, plumose, formed of lanceolate lamellæ, disjoined, disposed in two series. Foot large, cylindrical, terminated by a disciform expansion, fimbriated at the margin.

Sp. *Solenomya mediterranea, Tellina togata* POLI, I. Tab. 15, fig. 20, DESH. *Conchyl.* Pl. 3, figs. 15—17. The animal is figured by DELLE CHIAJE *Memorie sulla storia e Notom. degli Anim. s. v.* Tab. 62, figs. 10, 11, PHILIPPI in WIEGMANN *Archiv für Naturgesch.* 1835, Taf. IV. s. 171—176, and DESHAYES in CUV. *R. Ani., éd. ill., Moll.* Pl. 115. Comp. also DESHAYES *Encycl. méth., Vers.* III. pp. 956, 957.—*Solen australis* LAM., BLAINV. *Malac.* Pl. 79, fig. 1.

Family XXII. *Pholadacea.* Mantle sacciform, open anteriorly, with a fissure emitting the truncated foot. Two fistulous tracheæ, very long, conjoined in most, contained in a common covering. Branchiæ elongate, free at the apex, produced within the tracheæ. Shell at each end gaping, with no ligament, a styliform or spoon-shaped process at the hinge in each valve advancing into the cavity of shell.

*Pholas* L. Shell inequilateral, elongate posteriorly, thin, equivalve. External accessory calcareous parts at the hinge. Animal (*Hypogœa* POLI) with foot short, thick, its disciform apex flat or excavated. Two long tracheæ conjoined.

*Stone-borers* (*φωλάς* from *φωλέω*, to lie hid in a hole); some of these animals live at the bottom of the sea near the strand; others penetrate very hard rocks, madrepores, corals, &c.—From the opening at the hinder end of the shell turned upwards proceed the two connected tubes into which the mantle is prolonged. The mantle is thrown over the hinge, and contains small supernumerary pieces of shell of various form in the different

species. The points of the shell are covered with calcareous inequalities, which are connected by transverse projecting parallel lines at the inside with the margin of the hinge.

Sp. *Pholas Dactylus* L., POLI *Test. utr. Sic.* I. *Testac. multiv.* pp. 40—50, Tab. VII. figs. 1—11, Tab. VIII.; in the Mediter. and N. Seas, edible, and, as is said, of agreeable taste. PLINIUS speaks of the phosphorescence of this animal in the dark, *Hist. nat.* Lib. IX. cap. 61;—*Pholas crispata* L., CHEMN. *Conchyl.* Tab. 102, figs. 872—874, *Pholas costata* LAM. (*Phol. costatus* L.), BLAINV. *Malac.* Pl. 79, fig. 6, &c. Some fossil species are known from the tertiary formations.

*Teredina* LAM. Two valves furnished internally with cochleariform tooth, covered at the hinge with a shield, grown to a calcareous tube, elongate, conical, closed at one extremity, open at the opposite. (Fossil species.)

Sp. *Teredina personata* LAM., *Ann. du Mus.* XII. Pl. 43, figs. 6, 7, BLAINV. *Malac.* Pl. 81, fig. 5.

*Teredo* L. Mantle tubular, terminated by two tracheæ concrete at the base, open anteriorly for the passage of foot, short, truncated. Shell equivalve, gaping on both ends, small, covering the anterior part of the animal like a ring. Animal inhabiting a cylindrical tube covered with calcareous substance, and adhering to it by two calcareous pinnæ (*palmulæ*) placed at the base of tracheæ.

*Pile-worm.* These animals live in wood, which they perforate in all directions. The cavity in which they reside is covered with a calcareous incrustation, but the true shell is bivalve and much smaller than the mantle. How they penetrate and bore through the wood is not yet sufficiently explained. They grow in the wood, and do not first enter it as adult animals, for the external aperture, towards which the two tubes (*tracheæ*) are turned, is too narrow to allow the inclosed animal to enter, however it may have been able to make itself a way at an earlier period.

LINNÆUS placed this genus incorrectly between *Serpula* and *Sabella* (amongst the ringed worms), and named the bivalve shell the jaws of the animal. He united all the individuals that had been described up to his time under one species, *Teredo navalis*, which is a collective name. The species even now are far from being sufficiently distinguished. See SPENGLER *Skrivter af Naturh. Selskabet*, II. 1. Kjöbenhavn, 1792, pp. 99—106, and QUATREFAGES *Mém. sur le genre Taret, Ann. des Sc. nat.* 3ième Série, Tom. XI. 1849, *Zoologie*, pp. 19—73, Pl. I. II. The anatomical investigations of the writer named last, are the latest and the most complete: of the internal structure, to say nothing of older writers, notices in modern times have also been given by DESHAYES, in the *Exploration scientifique de l'Algérie* (1846), and FREY *und* LEUCKART (*Beiträge zur*

*Kenntniss wirbelloser Thiere*, Braunschw. 1847, 4to, s. 46—53). They are, according to QUATREFAGES, of distinct sex, but the male individuals are much rarer than the female.

For the distinction of species recourse is had amongst other characters to the form of the two small shovel-shaped calcareous plates which are placed below on the mantle, at the base of the tracheæ, and are commonly named *palmulæ*. One species, famous for the injury it caused to the piles of the dykes in Holland, in the beginning of the last century especially, might be named *Teredo Sellii* (*Teredo navalis* L. et auctor. in part, *Teredo batavus* SPENGLER). It is figured in the work of SELLIUS and in BLUMENBACH *Abh. naturhistorischer Gegenstände*, No. 89. The *palmulæ* are fixed on a short pedicle, inversely triangular, and terminating at the broad end on each side in a point. Piles that had been driven only six or seven weeks previously were seen to be entirely eaten through by this worm, and robbed of all their strength. In this way the island of Walcheren was in 1730 threatened with destruction. From time to time the same mischief was discovered in other places, especially on the *Zuiderzee* near Medemblik, Lambertshagen, &c.; West-Friesland was forced in consequence to mask its dykes with large stones, which being brought into the country from abroad, occasioned a great expense; according to MARTINET, *Catechismus der Natuur*. III. bl. 33, f. 5,600,000 were applied to the first repair of these dykes. Since the middle of the last century the mischief has much diminished, so that hence may be explained the fact, that even in the national museums only a few specimens of *Teredo* are preserved. This injury to our dykes was the occasion of many writings, which however contributed little to the advancement of science. We suffice ourselves with citing the large work of G. SELLIUS, *Histor. nat. Teredinis*. Traj. ad Rhen. 4to. Fossil *Teredines* also are found in the tertiary formations and in the chalk strata.

### *Septaria* LAM.

Sp. *Septaria arenaria* LAM., *Serpula polythalamia* L., RUMPH. *Amb. Rariteitk.* Tab. 41, figs. D, E. A long conical tube, with irregular constrictions and corresponding septa projecting internally; at the thin end are two calcareous pipes. The description of RUMPHIUS already indicates that the enclosed animal has much agreement with *Teredo*. This was confirmed by the discovery of a similar species in the Mediterranean a few years ago by MATHÉRON (*Septaria mediterranea* DESH. *Conchyl.* Pl. 2, figs. 9, 10). The animal with its small shell is contained in the tube that sticks in the sand. Perhaps this genus might be united with *Teredo*, as has been the Indian species figured by HOME under the name of *Teredo giganteus* (*Phil. Transact.* 1806).

Family XXIII. *Tubicola*. Mantle sacciform, cloven anteriorly for the passage of a rudiment of foot; two tracheæ conjoined into a fleshy pipe. Animal clavate anteriorly. Bivalve shell gaping, without cochleariform process, with hinge edentulous linear, contained in a calcareous tube, or concrete with the wall of the tube.

*Gastrochæna* SPENGLER (*Fistulana* BRUG., LAM., and *Gastrochæna* LAM.). Shell thin, equivalve, gaping at both ends, with hinge linear edentulous, and ligament external elongate. Calcareous tube clavate, including the bivalve shell. Mantle with a small aperture for the passage of a short foot, furnished with a small byssus. Two tracheæ coalesced, long, very contractile.

Sp. *Gastrochæna mumia* SPENGL., *Fistulana clava* LAM., SPENGL. *Skrivter af Naturh. Selskab.* II. 1, Pl. 2, fig. 1, BLAINV. *Malac.* Pl. 81, fig. 3; on the coast of Coromandel; the tube is free, and grains of sand often adhere to it. Other species, still, live enclosed in holes of madrepores and other stony polyparies; in these the calcareous tube was seen above the head, and they were separated from the preceding as a distinct genus (*Gastrochæna* LAM.). [The name *Chæna* substituted for *Gastrochæna* by A. J. RETZIUS (*Nova Testaceor. Genera*, Diss. def. a L. MUENTER PHILLIPSON, Lundæ, 1788, p. 19), although adopted by SPENGLER, has found no favour.]

*Clavagella* LAM. Sheath tubular, calcareous, free or enclosed in other marine bodies, clavate, and often covered with spines, or terminated by a cloven disc or calcareous branched tubes. One valve fixed in the wall of tube, the other free, contained in the cavity of tube.

Most of the species of this genus are fossil, and occur in tertiary formations, as *Clavagella echinata* LAM., *Ann. du Mus.* XII. Pl. 43, fig. 9, *Clav. baccillaris* DESH. *Conchyl.* Pl. 1. figs. 4—10. A recent species is *Clav. aperta* SOW., CUV. *R. Ani., éd. ill., Moll.* Pl. 117, fig. 2, from the Mediter., also *Clavag. lata* BROD., of which the animal was described and the anatomy given by OWEN; see W. J. BRODERIP and R. OWEN in *Transact. of the Zool. Soc.* I. 3, 1835, pp. 261—271, Pl. 35, figs. 1—8, Pl. 30, figs. 8—16.

*Aspergillum* LAM., *Penicillus* BRUG., *Arytene* OWEN. Bivalve shell incrusted in the wall of calcareous tube. Tube cylindrico-clavate, open at the narrow part, at the opposite end closed by a disc supplied with numerous tubular foramina and a central fissure.

Sp. *Aspergillum Javanum* LAM., *Serpula penis* L., RUMPH. *Amb. Rariteitk.* Pl. 41, fig. 7, BLAINV. *Malac.* Pl. 81, fig. 2; from the Indian Sea;—*Aspergillum vaginiferum* LAM., *Arytene vaginifera* LEUCK., RUEPPELL *Atl. zu der Reise im nörd. Afrika, wirbellose Thiere*, 1828, Tab. XII.; in the Red Sea. These animals live in the sand of level beaches and banks, and fix themselves in it with the broad end of the tube. The animal, which is club-shaped, became first known through RUEPPELL'S *Travels*.

# CLASS XIII.

## MOLLUSCS (*MOLLUSCA*).

ALTHOUGH the name *Molluscs* has a more general signification, and is also so used by us in this work, yet we prefer employing it in a more limited sense for a class of animals which, in the former edition of this handbook, we named cephalophorous molluscs. Names of classes ought in our judgment to be short and not to be confounded with definitions or descriptions. LAMARCK too has already given the name of molluscs in the same sense to this division of the animal kingdom.

The animals of this class have a head more or less distinct from the rest of the body. This head usually contains special organs of sense for touch and vision, sometimes even for hearing. Many of these animals have a shell, others are naked. Most of them live in water, but some on land, which in the two classes immediately preceding is never the case. However there are amongst these animals very different degrees of perfection in the organisation, yet we observe the same difference more or less in other classes also of invertebrate animals, nay even in the last class of vertebrates, that of fishes[1]. Accordingly we must here trace the principal differences in the arrangement of organs according to the natural groups and families.

The oral cavity of molluscs forms a very muscular expansion, at the base of which lies an organ, usually named tongue, which is covered by little teeth or hooks placed in transverse rows. In some this tongue is short and broad, in others ribbon-shaped and long[2]. Above the tongue is a transverse horny plate with projecting lines

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[1] Here let it suffice to point to *Myxine*, and especially *Amphioxus*; comp. also what we said above, pp. 34, 35.

[2] Compare on this subject F. H. TROSCHEL *Ueber die Mund-theile einheimischer Schnecken*, WIEGMANN'S *Archiv*, 1836, Bd. I. s. 257—279, Taf. IX. X., and especially LOVÉN in *Öfversigt af Kongl. Vetensk-Akademiens Förhandlingar*, 1847, pp. 175—199, who has described and figured these teeth in very many genera. That these hard parts consist of silex was observed by HANCOCK and EMBLETON in *Eolis. Ann. of Nat. Hist.* XV. 1845, pp. 9, 10.

(*Helix*, *Limax*), or at the side of it two jaws are found. The intestinal canal has various lengths, but is usually tortuous and longer than the body; it is very long, for instance, in *Chiton* and *Patella*, and makes many convolutions which are straitly enclosed by the liver. The œsophagus is sometimes expanded at the lower end like a crop, as in *Limnæus*, *Planorbis*, *Nautilus* and *Octopus*, which has longitudinal folds like those usually occurring in the œsophagus. The stomach is in some, as in *Helix*, membranous, in others muscular. In many this muscular stomach is armed internally with hard parts, as in *Scyllæa*, *Bulla*, *Bullæa*, or the inner membrane is horny, as in *Tethys* and the *Cephalopoda*, just as it is in gallinaceous birds. There are often found pieces of *Crustacea* in this stomach, whence it may be concluded that a hard covering of this kind is serviceable for crushing hard food. In some the stomach is compound, as in *Onchidium* and *Aplysia*, in which three (or in the last named genus, according to CUVIER, even four) stomachs are present. The first stomach is here membranous, the second muscular, armed internally with larger cartilaginous teeth placed in circles alternately, and with a single row of smaller teeth at the upper edge; the third stomach is armed on its inner surface with hooks which are curved forwards; the fourth, finally, is an elongated blind sac, which is surrounded by the liver. According to OWEN, this blind sac may be a secreting organ, a *pancreas* in the simplest form, corresponding to the cœcal appendages at the inferior orifice of the stomach in fishes[1]. As such also he regards the so-called second stomach in the Cephalopods, a membranous blind appendage behind the muscular stomach, which in *Sepia* and *Octopus* incloses a spiral membranous valve, and in *Nautilus* is parted into many chambers by thin transverse membranous valves[2]. The termination of the rectum in molluscs is usually situated on the right side of the body, always in the neighbourhood of the respiratory organs.

Salivary glands, which are wanting in the preceding class, appear very constantly to be present in this. Commonly there are

[1] *Lectures on the compar. Anat. of the invert. Anim.* p. 300; sec. ed. p. 557.

[2] In some cephalopods there are *folliculi*, larger than the liver itself, which are attached to the gall-ducts; HUNTER regarded these as *pancreas* (*Physiol.* Catalogue I. p. 229), in which opinion V. SIEBOLD also participates. *Lehrb. der vergl. Anat.* s. 393.

two of them, but in many Cephalopods and some Gasteropods, as in *Ianthina*, there are four; in this case the anterior pair is situated very close to the mouth.

The liver is much developed. A gall-bladder is not present in this class, and the secretion of bile is not effected from venous but from arterial blood. In *Helix* the liver is divided into four large lobes. In *Testacella* the liver is double, one on each side, whilst there are three of them in *Onchidium Peronii*, each with a distinct gall-duct; two of these ducts implant themselves in the œsophagus, so that the bile may act upon the chyme as soon as it is in the stomach. In many Cephalopods also the liver is formed of several lobes distinct from each other. The colour is yellow-brown or, as in *Nautilus*, dark wine-coloured red. The finer structure of the liver consists of numerous blind branched follicles which are covered internally by a stratum of bile-forming cells[1].

The urinary secretion is not wanting in Molluscs, although it has not yet been determined in all of them what organ effects it. JACOBSON first observed that in the calcareous sac of *Helix* and *Limax*, which CUVIER had named the mucus-secreting organ[2], uric acid is present, and that this part ought to be named the *kidney* of Molluscs[3]. This organ is a sacciform cavity provided internally with numerous folds or laminæ which is situated near the heart and has an efferent duct that terminates close to the respiratory aperture. In the Ctenobranchiates, as *Murex* and *Buccinum*, the same is described as the organ which secretes the purple fluid, and the duct opens into the branchial cavity. In the cephalopods the spongy appendages of the venous stems are to be regarded as kidneys[4].

[In several families of this class it has been shewn that in those molluscs which live in water, the urinary organ performs still

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[1] Comp. J. FRANK *De Hepate Molluscorum*, Berolini, 1844, 8vo, T. F. G. SCHLEMM (see above, p. 605), H. G. LINDNER *Nonnulla de Hepate et Bile evertebratorum*, Berolini, 1844, 8vo, H. MECKEL in MUELLER'S *Archiv*, 1846, s. 9—12.

[2] *Organe de la viscosité*, see *Ann. du Mus.* VII. p. 165, Pl. 8, figs. 2, 3, 4, *h*, *i*, Pl. 9, fig. 8, *b b*, fig. 10, *c* (*Mémoire sur les Moll.* No. XI); M. LISTER described the same organ under the name of *viscus cinereum*. *Exercitat. anat. de Cochleis*, Londini, 1694, Tab. 1, fig. 1, *d*.

[3] *Journal de Physique*, Tom. 91, p. 318, MECKEL'S *Archiv*, VI. 1820, pp. 370, 371; *Bidrag till Blöddyrenes Anatomie og Physiol.*, Kjöbenhavn, 1828, pp. 24—28.

[4] See the full account of observations and opinions relating to this subject in V. SIEBOLD *Lehrb. der vergl. Anat.* s. 391—401.

another function, viz. that of introducing water for its admixture with the blood. In the Pteropods, in which HUXLEY first observed it, GEGENBAUER has shewn that this sac with thick spongy walls, always seated within the mantle and in the neighbourhood of the heart, communicates on the one hand with the respiratory cavity by an aperture provided with circular and longitudinal muscular fibres, and on the other with the pericardial sinus by a tubular opening, which has a sphincter muscle and cilia at its extremity[1]. In the Heteropods it has the same relations with the branchial cavity and the pericardial sinus[2]; except that in *Firiloïdes*, which has no respiratory organ, it opens externally on the right side of the body near the vent[3]. In the *Ctenobranchiata* LEYDIG has shewn in *Paludina vivipara*, that the triangular kidney, situated near the heart, and receiving venous blood on its passage to the gill, communicates with a wide space which is at once its expanded duct and a sac receiving water from the gill-cavity by a minute aperture. The water of this sac contains blood-globules, so that a direct communication between the water and the blood may be presumed to occur in the substance of the kidney[4]. In the *Gymnobranchiata*, on the other hand, the kidney is described by HANCOCK and EMBLETON as a branched, tubular, spongy organ, inextricably connected with the liver on which it lies, and opening by a duct near the vent, but presenting no other aperture. It receives, according to these writers, blood partly from the aorta and partly from a pulsatory sac which delivers its contents also to the liver. They regard this sac as a portal heart to which the pericardial sinus serves as an auricle[5]; though by others it is regarded as the kidney[6].]

The heart is constantly arterial, that is, it receives the veins of the respiratory organs and gives off the arteries of the body. In

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[1] [HUXLEY *Morphology of Cephalous Mollusca, Phil. Trans.* 1853, p. 43, GEGENBAUER *Untersuch.* &c. pp. 20—23.

[2] HUXLEY l. l. p. 61, GEGENBAUER l. l. *Atalanta*, pp. 121, 123; *Carinaria*, pp. 148, 149, and *Zeitsch. f. wissensch., Zool.* v. s. 115.

[3] HUXLEY l. l. p. 33, LEUCKART *Untersuch.* III. 1854, pp. 55—57.

[4] LEYDIG *Zeitsch. f. Wissensch., Zool.* II. pp. 175, 176. Pl. XIII. fig. 49.

[5] HANCOCK and EMBLETON *Anatomy of Doris, Phil. Trans.* 1852, pp. 226—228.

[6] LEUCKART *Zoolog. Untersuch.* III. 1854, p. 55.]

some (*Haliotis, Crepidula,* &c.) the rectum, as in most of the bivalves, passes through the heart. Usually the veins of the respiratory organs are collected in a membranous auricle (*atrium*), to whose broader part the broad part of the conical ventricle of the heart is attached. In most of the Cephalopods three hearts are present; namely, two lateral hearts that drive the venous blood to the gills, and a larger arterial heart placed in the middle, that receives the veins of the gills. The blood of molluscs is whitish; it is brown, sometimes green or red in some *Gymnobranchiata*, where the colour of the body often depends upon that of the blood[1]. Blood-corpuscles are present in smaller quantity than in vertebrate animals; they are round, in some degree flat and often filled with little granules.

The venous part of the circulating system is always more or less imperfect. CUVIER had noticed in *Aplysia* as early as the beginning of this century, that, in place of a *vena cava* and of branchial arteries, spaces are present, which are perforated like meshes and communicate freely with the cavity for the intestines[2]. This disposition was, however, regarded as an exception. Within the last few years it first became apparent, especially from the investigations of MILNE EDWARDS, that a large part of the circulating system in all molluscs is formed by interspaces, which surround the different organs of the body and are bounded by no special walls[3]. The venous blood bathes the viscera, and is received into the cavity in which these are contained, as into a *sinus*, before being distributed to the respiratory organs. The vessels which conduct the blood to these organs (the branchial arteries), do not originate in capillaries, but have often very conspicuous apertures; in some the venous system appears to be entirely absent, with the exception of the branchial veins which, conveying arterial blood, run to the heart[4]. In some

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[1] E. FORBES in *Annals of Nat. History*, VI. 1841, p. 317.

[2] *Ann. du Mus.* II. pp. 299, 300, *Mém. s. l. Moll.* No. 9, Pl. II. fig. 1, G. L. figs. 2, 3.

[3] [See note 2, p. 710.]

[4] See MILNE EDWARDS *Ann. des Sc. nat.*, 3ième Sér. Tom. III. *Zool.* 1845, pp. 289—315, pp. 341—353, Tom. VIII. *Zool.* 1847, pp. 37—76. In *Octopus* the visceral cavity, in *Loligo* the cavity surrounding the muscular bulb of the mouth, forms a venous sinus.

molluscs the arterial system also is imperfect, especially in the nudibranchiates[1].

Some molluscs breathe atmospheric air by a cavity rich in vessels; others, and indeed the greatest number breathe, as fishes do, the air diffused through water by means of gills. The form of the gills is very various, as will be explained in the view of the different families in the systematic arrangement. In those that have a shell, this is a special protection for the respiratory apparatus, and is usually situated, whenever it does not cover the entire animal, upon these organs.

In the organs of propagation in molluscs great variety prevails. Some are bisexual, others have distinct sexes.

In those molluscs in which the sexes are distinct, no external difference is on the whole to be observed; an extremely remarkable exception to this is however formed by the genus *Argonauta* amongst the Cephalopods, in which the male individuals have hitherto been entirely unrecognised, as will be explained in the sequel when we treat of this genus. In some there are no external sexual or copulating organs present, and here, as in the bivalves, the sexual difference can alone be recognised by microscopic investigation of the content of the secreting organs, which has been done within the last ten years in *Chiton*, *Patella*, and *Haliotis* (the *cyclobranchiata* and *aspidobranchiata*), which were formerly supposed to be all bisexual or rather female[2]. In others, on the contrary, a copulation occurs, at least an approximation as in the Cephalopods. Here there is a *penis* also, which in *Buccinum* is of unusual size, in the Cephalopods short only. The *testis* or the ovary is single and lies in the *Gasteropoda* close to the liver. In *Nautilus* the oviduct has a free opening on each side, and thus the eggs do not come, as is elsewhere the general rule with invertebrate animals, immediately by a closed canal from the ovary.

Amongst those molluscs which are hermaphrodite, to which, besides many *Gasteropoda*, the *Pteropoda* belong, the arrangement of the sexual apparatus has been best investigated in the genera *Helix* and *Limax*. In these animals, backwards close to the liver

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[1] In *Haliotis* and *Patella* MILNE EDWARDS found an arterial cavity in the head, in which the large artery ends freely forwards.

[2] Compare what we said above on a similar opinion respecting bivalves, p. 713.

a gland is situated, which consists of many long blind sacs that unite digitally, whose branches or roots in consequence unite to form a single efferent duct. This duct then runs along the inferior extremity of another larger gland, elongate, and often ending like a tongue; this last was regarded by CUVIER as the *testis*, and the smaller compact gland as the ovary. An exactly opposite opinion was advanced by TREVIRANUS[1], which however was contradicted by CARUS, who found eggs in the first-named gland[2]. With this other observations again were in conflict which proved the presence there of *spermatozoa*. The matter seemed inexplicable, until its true bearing was illustrated by the microscopic investigations of H. MECKEL[3]. The gland which CUVIER names ovary, TREVIRANUS *testis*, is both one and the other; it is a double, truly hermaphrodite gland; every *folliculus* is double, and within the external, which contains eggs, an internal is enclosed with seed and *spermatozoa* in different states of development. The tongue-shaped organ, regarded by CUVIER as *testis*, is a gland secreting albumen, and covering the eggs with its secretion. Hence this organ becomes tumid subsequently to copulation, as on the other hand the true sexual gland, according to CUVIER the ovary, after the time of copulation shrinks up[4]. The *penis* is a long filiform organ, capable of eversion, which in copulation is received within a tube that terminates at the end in a round vesicle[5].

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[1] *Zeitschr. für Physiologie*, I. 1824, s. 1—30, *Ueber die Zeugungstheile und die Fortpflanzung der Mollusken*. So also PREVOST, who found *spermatozoa* in the compact gland. *Mém. de la Soc. de Physique et d'Hist. nat. de Genève*, IV. V. and *Ann. des Sc. nat.* XXX. 1833, pp. 43—59, Pl. 5.

[2] CARUS *Beiträge zur genauern Kenntniss der Geschlechtstheile einiger Gasteropoden*, MUELLER'S *Archiv*, 1835, s. 487—499, Taf. 12, figs. 1, 2.

[3] MUELLER'S *Archiv*, 1844, s. 484, Tab. XIV. fig. 18.

[4] On this account especially the opinion of CUVIER was contested by M. G. VERLOREN in his prize essay, *Commentatio de Organis generationis in Molluscis gasterop. pneumonicis*, which contains several good figures and accurate descriptions with an historical review, very complete up to that time of the different previous observations and opinions. *Ann. Acad. L. B.* 1836, 1837. Comp. also A. PAASCH *de Gasteropodum nonnullorum hermaphroditicorum systemate genitali et uropoëtico*. Berolini, 1842, 8vo.

[5] This vesicle was aleady compared by DESHAYES and PREVOST to the *poche copulative* of insects (see above, p. 266). The last writer established by actual observation that the *penis* in *Limnæi* is received at the time of copulation by the pedicle of the vesicle. Moreover the pulmonary gasteropod molluscs present an arrangement which is not easy to reconcile with the opinions of STEENSTRUP, whose work we alluded to

Most molluscs are oviparous; only few, as *Paludina vivipara* and *Clausilia ventricosa*, are viviparous. Development from the egg begins with a cleaving or separating of the yolk, as has been already noticed by us in other classes of animals. Presently the yolk begins after a longer or shorter period to rotate round an axis, which at first occurs more feebly, afterwards more rapidly and regularly. With this rotatory motion a progressive one is connected by which the yolk describes a circle. These motions are caused by cilia. It is to be remarked, that, according to the observations of SARS, LOVÉN and others, young marine molluscs universally, though they be afterwards naked, possess a shell which like that of Nautilus is volute and covers the hind part of the body. Also these molluscs undergo a remarkable change of form, since, before tentacles appear, a large thin membrane, divided into two lobes, surrounds the mouth. This part (*velum*) is surrounded by cilia, and is the principal organ of motion. In some molluscs this organ is found to be persistent, most conspicuously in *Tethis*, where the fine cilia surrounding the margin are replaced by *cirri*[1].

The power of restoration is in some species of this class very great. In various *Helices* the reproduction of the head that has been (partly) excised and of antennæ has been observed by SPALLANZANI, SENEBIER, and BONNET[2]. That the entire head grows again, as the experiments of SPALLANZANI appeared to indicate, may however be doubted, since the anatomical investigation of such snails as had been preserved by this observer in spirit afterwards proved that by the excision the first or cerebral ganglion had not been removed[3].

The nervous system of molluscs presents various degrees of development in the different orders and families. It may be regarded as the general type, that there is a central mass above and

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(p. 135), and it is not apparent from his figures why he considers Tab. II. fig. 1, to represent a female, fig. 2 a male individual of *Helix pomatia*.

[1] For the sake of brevity it must suffice that we cite the investigations of C. VOGT, *sur l'embryogénie des Mollusques gastéropodes, Ann. des Sc. nat.*, 3e Série, Tom. VI. 1846, pp. 5—90, Pl. 1—4, where, besides, the earlier observations are noticed historically.

[2] See of the last-mentioned *Œuvres d'Hist. natur. et de Philosophie*, 8vo. XI. 1781, pp. 1—61.

[3] SCHWEIGGER *Naturgesch. der Skelettl. ungegl. Thiere*, s. 629, 630.

another below the œsophagus, each of which consists of two lateral portions, that either remain distinct or are more or less fused together to form an over- and an under-lying ganglion. From the central nerve-mass situated above the œsophagus, or from the two lateral ganglia when these, as in *Patella, Haliotis, Bulla*, &c., are only united by a transverse commissure above the œsophagus, arise the nerves of the eyes, of the feelers and of the mouth. On each side this brain-like central organ is united with the central mass lying under the œsophagus by one or more nervous filaments (in *Helix* by three). The nervous ring, thus formed, surrounds the œsophagus, and is in many short, because the central masses are situated near the fore part of the body and in the neighbourhood of each other; only in some is this ring very long, as in the *Heteropoda*, because the second central mass is situated backwards. In many nudibranchiates the central nerve-mass placed above the œsophagus is much developed, and that which lies beneath it feebly; in the *Ctenobranchiata* also the first nerve-ganglion that lies over the œsophagus is much larger than the second which lies under it. The converse occurs in the *Pteropoda*, where the uppermost or cerebral nerve-center is ordinarily represented by a transverse commissure alone above the œsophagus. From the central nerve-mass, situated below the œsophagus, and consisting of a greater or less number of different ganglia, arise the nerves for the viscera, the respiratory and generative organs. In some several ganglia or nerve-masses remote from each other are present, as in *Aplysia*, where a distinct ganglion is situated backwards at the origin of the *aorta*. The nerve-ganglia are often coloured red, as in the genus just referred to, in *Limnæus, Planorbis*, &c., by a substance situated under the neurilema. In various molluscs a nervous system corresponding to that of the visceral nerves of articulate animals has also been observed[1], of which the anterior portion consists of small ganglia that lie at the side of the œsophagus, and are connected by nervous filaments with the cerebral ganglion, whilst backward, from one or two ganglia, branches are given off to the intestinal canal, the liver, and the organs of propagation[2].

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[1] Comp. above in the treating of Insects, p. 278.

[2] The nervous system has been described and figured in different Gasteropods, especially by CUVIER in his *Mémoires pour servir à l'Hist. et à l'Anat. des Mollusques*; see

The organs of sense are more developed, as a rule, in this than in the two preceding classes. The head is usually furnished (in most *Gasteropoda*) on the upper surface with two feelers, on the outer margin of which the eyes, sometimes on two little tubercles or pedicles, are situated. When the eye-supporting pedicles are developed independently, two pairs of feelers are present. In some these feelers are hollow and can be everted like the finger of a glove after they have been drawn in, as may be seen in the common snail. Besides these feelers situated on the head, different productions of the mantle are probably the seat of a finer sense of touch, as the *cirri* round its margin in *Patella* and *Haliotis*. The folded and indented fringe or circular lip in the *Cephalopoda*, the various feelers round the mouth in *Nautilus*, may also be regarded as organs of tact.

Taste cannot be very highly developed, since the tongue, as we stated above, is horny. Of the organ of smell nothing certain is known, although in *Nautilus* a part, first pointed out by VALENCIENNES, situated close to the eyes, may probably be regarded as such. That, however, many molluscs possess the sense of smell seems to be demonstrated by observations; thus SWAMMERDAM found that vineyard snails, when he brought fresh food near them, came out of their house and crept quickly towards it. According to CUVIER the entire mantle that covers these animals may be analogous to the pituitary or mucous membrane of the nasal cavities, and thus very appropriately the organ of smell[1].

The auditory organ was known in the Cephalopods alone a few years ago. In the cartilage of the head two small cavities are found, which enclose a sacculus filled internally with a fluid, whilst it is surrounded also by a fluid substance and attached to the larger cavity, in which it is suspended by numerous fibrous threads. In this sac, in most species, there lies a calcareous round or conical little stone. The auditory nerve penetrates the saccule, and divides into fine branches on its inner surface. There are neither apertures,

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also GARNER in *Linn. Transact.* Tom. XVII. cited above, p. 716. For the nervous system of the *Cephalopoda* see below on this order.

[1] *Leçons d'Anat. comp.* II. p. 676. BLAINVILLE, who regards the antennæ of insects as olfactory organs, ascribes similarly to the feelers of molluscs the capacity of smell. *Principes d'Anat. comp.*

nor other external parts of the auditory organ present[1]. It is only within the last ten years that a knowledge has been attained of the auditory organs of *Pteropods* and *Gasteropods;* they are two round saccules filled with fluid, each containing a small otolite or numerous calcareous concrements, and situated on the central nerve-mass beneath the œsophagus, or in some behind the eyes, in which case they receive a nervous branch from the cerebral ganglion[2].

In most molluscs two small eyes are present, in the Cephalopods alone are they large. They never occur in greater number, nor dispersed over other parts of the body, but are always situated on or near the head; in some they are non-pediculate and are placed at the base of the feeler, or stand on tubercles or sometimes at the point of the feeler, as we lately stated. In *Nautilus* they are seated on little pedicles at the side of the head, like hemispheres flattened on the anterior surface. In the rest of the *Cephalopoda* they lie in lateral excavations of the cartilaginous ring of the head, protected in some degree by two long, thin, oval cartilaginous plates in front. In the *Gasteropoda*, SWAMMERDAM formerly investigated the eyes anatomically; in our century this investigation has been repeated and extended, especially by STIEBEL, MUELLER, and KROHN. Under the skin, that in this situation is destitute of pigment, lies the eye-ball, enclosed by a proper membrane (*sclerotica*), which is transparent in front, and sometimes very convex (*cornea*). The vascular choroid, coloured by a black pigment, is furnished with an annular aperture (just as an *iris* is). A spherical lens and a vitreous body occupy the interior of the eye-ball, whilst the optic nerve expands within the choroid into a cup-shaped *retina*[3].

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[1] See SCARPA *Anat. disquisitiones de Auditu et Olfactu*, Ticini, 1789, fol. pp. 5, 6, Tab. IV. figs. 7—9, CUVIER *Mém. s. l. Mollusq.* No. I, p. 41, &c.

[2] See EYDOUX and SOULEYET *l'Institut. Journal générale*, &c. Tom. VI. 1838, p. 376; KROHN, FRORIEP'S *neue Notizen*, 1840, 1841, s. 310—312; V. SIEBOLD, WIEGMANN'S *Archiv*, 1841, and *Ann. des Sc. nat.* 2e Série, Tom. 19, 1843, pp. 193—211, Pl. 2 B. These auditory vesicles appear very early in the development of the embryo, but are at first simply filled with fluid, from which the otolite or the calcareous concrements are separated at a later period only and gradually by crystalization; see FREY in ERICHSON'S *Archiv*, 1845, s. 217—222.

[3] SWAMMERDAM *Bijbel der Natuure*, I. bl. 105, 106; STIEBEL in MECKEL'S *Archiv*, V. 1819, s. 206—210, Tab. V.; JOH. MUELLER, MECKEL'S *Archiv für Anat. u. Physiol.* 1829, s. 208—212, Tab. VI. figs. 4—8, *Annal. des Sc. nat.* Tom. 22, 1831, pp. 7—19; KROHN, MUELLER'S *Archiv*, 1837, s. 479—485, and ibid. 1839, s. 332—337, Taf. X.

In the Cephalopods, the optic nerve is continued into a large reniform ganglion, which is surrounded by a white fatty mass divided into lobes, and is, with the eye-ball, surrounded by a common case, a fibrous membrane, by which a sac is formed, that is much larger than the eye-ball, and may be regarded as the capsule (*orbita*) of the eye. In front this membrane is attached to the common integument. There the skin becomes transparent, and sometimes forms, by duplicatures or folds, two eye-lids as it were. Behind this transparent membrane, perforated by a round opening, the eye-ball is situated. A cornea is not present, and thus also there is no anterior chamber, unless the space that intervenes between the transparent continuation of the common integument and the eye-ball be so named. Within the eye-case lies a tunic of a silvery lustre. The eye-ball itself has a cartilaginous external membrane, which is perforated behind like a sieve by the filaments of the optic nerve, and in front at the margin of the lens forms the circle of the pupil. This covering may be regarded as *sclerotica*. Within it lies the expansion of the optic nerve, the *retina*, which also contains a purple-brown pigment-layer. The lens is large, elongate, round, and at the posterior surface more convex than in front[1].

The muscles of molluscs are attached in general to the inner surface of the skin. They do not exhibit the transverse stripes on the primitive bundles which microscopic anatomy has detected in the muscles of articulate animals[2]. Those Gasteropods that have a

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figs. 6—8. KROHN confirmed SWAMMERDAM'S statement of the independent existence of lens and vitreous humour; whether an aqueous humour also is present, as SWAMMERDAM concludes, he leaves undetermined.

[1] On the eye of Cephalopods compare amongst others CUVIER *Mém. s. les Moll.* No. 1, pp. 37—41, Pl. 1. fig. 3, Pl. II. fig. 5; D. W. SŒMMERING *de Oculor. Sectione horizontali.* Gottingæ, 1818, fol. pp. 76—78, Tab. III.; KROHN *Nov. Act. Acad. Cæsar. Leop. Carol. N. C.* XVII. 1, 1834, pp. 339—366, Taf. 26; DUGÈS *Traité de Physiol. comp.* Paris, 1838, 8vo, 1. pp. 315—318. In *Nautilus* I am not able, any more than OWEN, to discover a trace of the lens; that this part should have escaped through the small aperture existing in the middle of the flat anterior surface of the eye, appears to me probable. Fresh specimens alone can afford a satisfactory solution.

[2] That they occur in *Sagitta*, is in my judgment a further proof that this animal is no mollusc. In Cephalopods also I cannot any more than in the muscular circular belts of *Salpa* (p. 695) discover these transverse stripes, though they have been adopted indeed in these animals, and also figured.

wreathed shell are affixed to it by a muscle which is attached to the uppermost turn near the columella, and descends along the turns to attach itself to the head by one portion, and to the hinder extremity of the foot by the other. This muscle, on its contraction, serves to draw the snail into its house.

Gasteropods advance also by creeping on the ventral disc, or foot, in which they fix alternately the fore part, then the hind part, to the surface over which they are moving, whilst the disc is contracted into sinuous transverse grooves that proceed from before backwards. Pteropods swim by means of the wing-like appendages that surround the mouth. The same purpose is served by the flaps of skin on the body of most Cephalopods, which are especially assisted when creeping on the bottom of the sea and in other motions, as seizing their prey, &c. by the muscular arms, furnished with suckers, that surround the head.

Molluscs, as to their geographical distribution, are not sufficiently ascertained, and it is difficult to form any general conclusions from comparison, since all countries, coasts, and seas, have not been investigated with equal care. Molluscs are more numerous than conchifers in great seas and on rocky coasts. In warmer regions they surpass the bivalves greatly in multiplicity of species. The greatest profusion of marine molluscs, as well as to genera as species, belongs, beyond doubt, to the great ocean between the west coast of America, and the east coast of Asia and New Holland. Tropical forms seem to extend more widely in the southern than in the northern hemisphere. Amongst the genera that are most numerous in species, we may here mention especially *Purpura*, *Mitra*, *Cyprœa*, and *Conus*; the species of the three last genera are almost all from the great ocean, and the East Indian sea. It is remarkable that the molluscs on the western and on the eastern coast of South America differ to such a degree, that there is scarcely a species that is common to both coasts. The genus *Chiton*, so numerous in species in the great ocean, is represented by a couple of species on the east coast of America. Species that dwell at considerable depths are naturally further dispersed than those which live more in the neighbourhood of coasts. Consequently it is not sufficient to ascertain the longitude and latitude of the districts within which certain species occur; the depth also of the sea ought to be ascertained in which they commonly live. With the depth

the number of species decreases, just as that of land animals does the greater the height is above the surface of the sea. Amongst the Cephalopods that have a shell, and which occur sparingly in the present creation, whilst in the previous world they were very numerous and different in form, *Nautilus* is confined entirely to the Indian and South Seas. Of the molluscs that live on land, no genus is more generally diffused than *Helix*, of which some hundreds of species are known, and which occurs in all regions. The species of molluscs are in a greater degree than those of bivalves confined to limited regions, and thus, on the whole, differ more in different countries[1].

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[1] Interesting contributions to the knowledge of the geographical distribution of molluscs have been made in the last few years by the investigations of SARS, FORBES, D'ORBIGNY, PHILIPPI and others. Compare A. D'ORBIGNY *Recherches sur les lois qui président à la distribution géographique des Mollusques côtiers marins, Ann. des Sc. nat.* 3e Série, Tom. III. 1845, pp. 193—221; E. FORBES *On the topographical distribution of marine Molluscs, Edinb. Phil. Journ.* New Ser. April, 1844, and *Ann. des Sc. nat.* 3e Sér. Tom. IV. pp. 117, 118, and LOVÉN's remarks on the geographical distribution of Scandinavian Marine Molluscs, *Öfversigt af Kongl. Vetensk. Akademiens Förhandlingar.* 1846, pp. 252—274.

# SYSTEMATIC

# ARRANGEMENT OF MOLLUSCS.

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## CLASS XIII.

### MOLLUSCA.

ANIMALS covered by a soft moist skin, mostly forming over the back a duplicature, free at the margin (*mantle*). Head more or less distinct, furnished with tentacles and often with two eyes. Shell calcareous, mostly univalve, in some multivalve, never bivalve; in a few internal, in some absent. Organs of circulation and respiration mostly distinct; heart always aortic. A nervous ring around the œsophagus; nerves proceeding from ganglia, various in number, towards the peripheral parts of the body.

Many aquatile, some terrestrial, almost all swimming or creeping.

### ORDER I. *Pteropoda.*

Molluscs furnished at the anterior part on both sides with a natatory expansion or pinna, with head often little distinct, hermaphrodite, marine.

*Wing-footed.* CUVIER first distinguished this division under this name in 1804. He characterised it by the absence of the foot or the ventral disc; this part, however, appears to be not so entirely wanting, though formed in a different fashion, especially laterally, and to be developed into the so-named wings or fins. Hence some writers, and amongst them SOULEYET, unite the *Pteropoda* with the *Gasteropoda.* At all events they have a closer alliance with these than with the *Cephalopoda,* and must, on account of the simplicity of structure, be placed below the *Gasteropoda.*

Compare on this order CUVIER *Ann. du Mus.* IV. 1804, pp. 223—234, *Mollusq., Mém.* No. 3;—PÉRON *Ann. du Mus.* XV. pp. 57—69 (this writer refers to this order several genera of *Mollusca*, which CUVIER placed elsewhere, and also the genus *Callianira* belonging to the *Acalephæ* (p. 121); J. F. J. KOSSE (*præside* J. F. MECKEL) *de Pteropodum ordine*, &c. Halæ, 1813, 4to; RANG *Ann. des Sc. nat.* V. 1825, pp. 283—287; XII. 1827, pp. 320—329, XIII. 1828, pp. 302—319;—P. J. VAN BENEDEN *Exercises zootomiques* (*Nouv. Mém. de l'Acad. royale des Sc. de Bruxelles*, XII. 1839) av. 4 pl.;—SOULEYET *Comptes rendus*, Tom. XVII. 1843, p. 662 et suiv.; HUXLEY *Anatomy of Pteropoda* in his paper *on the Morphol. of the Cephalous Moll., Phil. Trans.*, 1853, Pt. I. p. 39 and foll.; GEGENBAUER *Untersuch. Ueber Pteropoden u. Heteropoden, ein Beitr. Zur. Anat. u. Entwickelungsgesch. dieser Thiere, mit 8 lithogr. Taf.* Leipzig, 1855.

Family I. *Hyaleacea.* Pteropods with head indistinct, included posteriorly in a thin shell.

*Hyalea* LAM. (*Cavolina* GIOENI, ABILDGAARD, *Caulina* POLI). Shell thin, pellucid, flat above, convex beneath, cloven on both sides. Two large pinnæ at the sides of mouth. Mantle produced on both sides between the fissures of shell, with contractile appendages. Branchiæ arranged in a circle round the other viscera, fasciculate.

[In this family, the mantle, besides forming the general covering for most of the viscera, is inflected anteriorly on the ventral surface to form a pocket, which is the branchial cavity. The mantle sends processes laterally through the fissures of the shell in *Hyaleæ*, two large laminæ on each side, which meeting in the middle, cover the dorsal and ventral surfaces of the shell. Whilst the animal is alive this is their constant position, but when it dies they are retracted within the shell, and hence were not known until observed by GEGENBAUER. Besides these lamellæ there are contractile processes in *Hyaleæ* often six times the length of the body. They are frequently mutilated. All the different processes are less developed in *Cleodora* and *Creseis*, and none of them are thrown round the shell. A lobe that joins the pinnæ at their base represents the foot in this family. See GEGENBAUER l. l. s. 4, 5.]

Sp. *Hyalea tridentata* LAM., *Anomia tridentata* FORSK. *Icon. rer. nat.* Tab. 40, fig. B, BLAINV. *Malacol.* Pl. 46, fig. 2, DELLE CHIAJE *Memorie*, Tab. 80, fig. 1, CANTRAINE *Malacol. méditerranéenne, Mém. de l'Ac. de Brux.* XIII. Pl. I. fig. 3; in the Med. Sea, &c. Comp. on the genus *Hyalea*, BLAINVILLE *in Dict. des Sc. nat.* Tom. XXII. 1821, pp. 65—83.

*Cleodora.* [Shell very fragile. Animal without appendages of mantle produced over the shell.

GEGENBAUER l. l. s. 210.]

According to CANTRAINE it does not differ from the preceding genus, the shell is cloven at the sides as in *Hyalea*, l. l. p. 23.

Add genus *Eurybia* RANG *Ann. des Sc. nat.* XII. 328.

*Creseis* RANG. Shell subulate, furnished with an orbicular opening anteriorly, not cloven at the sides. Mantle not produced at the sides.

Comp. RANG *Ann. des Sc. nat.* XIII. pp. 305—318.

*Note.*—Here also or with the preceding genus is to be placed:

Sub-genus *Cuvieria* RANG. See *Ann. des Sc. nat.* XII. p. 322, Pl. 45 B, figs. 1—8, V. BENEDEN l. l. Pl. 4 B.

*Spiratella* BLAINV., *Limacina* CUV. Body anteriorly auriculate on both sides with a triangular pinna, posteriorly convolute. Shell fragile, discoidal, on one side deeply umbilicate, on the other with a spire slightly exsert.

Sp. *Spiratella arctica* nob., *Limacina helicinalis* LAM., BLAINV. *Malac.* Pl. 48 bis, fig. 5, V. BENEDEN *Mém. sur la Limacina arctica, Mém. de l'Ac. royale de Brux.* Tom. XIV. 1841, Pl. 5. This little animal is very numerous in the North Polar Sea, and serves the whale for food; see O. FABRICIUS *Faun. Grœnl.* pp. 387—389, by which writer it is named *Argonauta arctica*. In PHIPPS's Voyage towards the N. Pole it is noticed under the name of *Clio helicina*, and it is probable that CUVIER intended to name it *Helicina*, a name which we should prefer to that of *Limacina* which perhaps originated merely in a mistake.

*Cymbulia* PÉRON. Animal included in shell, except two large pinnæ, confluent [partially, with a middle lobe that represents the foot. GEGENB.]. Two contractile tentacles in front of mouth. Shell hyaline, elongate, cymbiform, truncated posteriorly.

Sp. *Cymb. Peronii* CUV., PÉRON *Ann. du Mus.* XV. Pl. 3; pp. 10—12, GUÉRIN *Iconogr., Moll.* Pl. 4, fig. 2, V. BENEDEN *Mém. de l'Acad. de Brux.* XII. Pl. 1; Mediter. Sea; according to CANTRAINE these animals often lose their shell. [The shell is formed within the mantle, and normally is covered by a thin lamella of the same. This last is easily torn and thus perfect specimens are rare: hence also the ease with which the animal loses its shell. The shell has the consistence of soft cartilage and contains *chitin*. GEGENBAUER l. l. pp. 41, 42.]

[*Tiedemannia* DELLE CHIAJE. Pinnæ conjoined with the foot to form an orbicular disc. Mouth at the apex of a long proboscis, very often bent backwards. Shell hyaline, gelatinous, slightly excavated.

Sp. *Tiedemannia neapolitana* V. BENED., proboscis slender, pinnæ with white and yellow spots at the margin. Length 2 or 3″. See GEGENBAUR l. l. s. 54—68 for the anatomy and development, gen. char. p. 212.]

Family II. *Clioïdea.* Naked Pteropods, with head distinct. [The small foot on the ventral surface never connate with pinnæ. GEGENB.]

*Pneumodermon* CUV. Two small pinnæ at the sides of neck with an intermediate grooved conical appendage. Mouth with numerous pediculated retractile suckers.

Sp. *Pneumodermon Peronii* CUV., *Ann. du Mus.* IV. Pl. 59 B, BLAINV. *Malac.* Pl. 46, fig. 4; this animal was discovered in the Atlantic Ocean by PÉRON, and appears to differ from that figured by QUOY and GAIMARD in the voyage of the *Astrolabe* (copied in CUV. *R. ani., éd. ill., Mollusq.* Pl. 17, fig. 2), where the suckers stand like branches on two pedicles. *Pneumodermon violaceum* D'ORBIGNY has a greater resemblance to it, the anatomy of which has been given by V. BENEDEN with figures in MUELLER'S *Archiv*, 1838, pp. 296—304, Pl. IX. X. There is still uncertainty respecting the respiratory organs, and the name PNEUMODERMON rests perhaps on a mistake. [*Pn. ciliatum* GEGENB., see the anatomy, &c. l. l. s. 74—100. The folds of the integument, here absent, which serve for respiration, are described in *Pn. violaceum* and *P. Mediterraneum*, pp. 85, 86.]

*Spongiobranchea* D'ORB. (Is this genus distinct from the preceding?)

D'ORBIGNY *Voyage dans l'Amér. mérid.* (transferred to OKEN'S *Isis*, 1839, s. 498, Tab. I. IX. figs. 1—9).

*Clio* L., *Clione* PALL., ESCHRICHT. Body oblong, acuminate posteriorly. Head distinct from body by stricture, covered by a bilobed hood, crowned by six conical appendages, and two retractile conical tentacles. Two oval pinnæ at the sides of neck. Two black points (eyes) in the back of neck. Two genital apertures at the right of the ventral side, the anterior in front of pinnæ for the exit of a very large penis, the posterior behind the pinnæ for the oviduct. Anus behind these orifices, more in the middle.

Sp. *Clio borealis* GMEL., *Clione borealis* PALL., *Spic. Zool.* X. Tab. I. figs. 18, 19, CUVIER *Ann. du Mus.* I. pp. 242—250, Pl. 17, D. F. ESCHRICHT *Kongl. Danske Vetensk. Selskabs Afhandl.* Kjöbenhavn, 1838 (published separately in German, *Anatom. Untersuchungen ü. d. Cl. boreal.* Kopenhagen, 1838, 4to.) The six conical arms of the head are beset with spots, microscopic suckers. This animal (Whale-bait), *Clio limacina* PHIPPS, lives with *Clio helicina* principally in the neighbourhood of Greenland and Spitzbergen, and forms the chief food of northern whales, although scarcely 1″ long. CUVIER regarded the fin-like appendages as respiratory organs, but

it was probably the reticulated muscular fibres that he took for vessels in these dermal lamellæ [*Olio Mediterranea* GEGENB., tentacles very short, no eye-points; *Cl. flavescens* GEGENB. G. thinks that the 3,000 suckers in each tentacle described by ESCHRICHT are merely forms of *epithelium*.]

## ORDER II. *Gasteropoda.*

Molluscs with head distinct, in most tentaculate, the inferior surface of abdomen flattened or grooved, or produced into a compressed lamina. Some hermaphrodite, others distinct in sex; many aquatic, some terrestrial.

*Gasteropods.* In most the heart lies on the left side of the body. In those, however, that have left-handed shells (see above, p. 684) the heart lies on the right side. In many the sexes are distinct; others are bisexual, so that mutual impregnation of two or sometimes more individuals occurs.

The inferior surface of the belly forms an elongate flattened disc, which is very muscular, as is commonly known in slugs and snails; these animals, met with everywhere, give an idea of the *typus* of this order. But in others, this ventral disc, usually named *foot*, is compressed laterally, and serves for swimming. We separate these molluscs from the rest as a distinct group.

Family III. A. *Heteropoda.* Foot compressed, resembling a fin, furnished with a disc or suctorial acetabulum. Branchiæ pectinate or pinnate. Sexes distinct.

*Heteropods.* These molluscs all live in the sea, and usually swim with the fin-shaped foot upwards, and the back downwards. FORSKÅL, to whom we owe the first description of this family of animals, gave them the name of *Pterobranchea.* The existence of distinct sexes was discovered by LAURILLARD and MILNE EDWARDS. [The part named 'Foot' is highly developed in this family, and in some attains a high potentiality (GEGENB.). It does not exactly correspond to the foot of Gasteropods, but to one part of it alone. HUXLEY (*On the Morphology* of the *Cephalous Mollusca, Phil. Trans.* 1853, Pt. I. pp. 29—65). A foot has four parts, the *propodium, mesopodium,* and *metapodium,* found in Heteropods, and a fourth, the *epipodium,* not found in them. The fin-shaped foot of heteropods is the *propodium.* Besides the works just referred to, comp. also, on this division, LEUCKART *Zoologische Untersuchungen,* Drittes Heft, Giessen, 1854, *Der Bau der Heteropoden,* pp. 1—68.]

*Pterotrachea* FORSK., *Firola* BRUG., PÉRON. Body naked, elongate, with integument almost pellucid. Two eyes. Tentacles (very often) none. Head with a fleshy proboscis. Branchiæ pinnate, free, at the posterior part of back.

Sp. *Pterotrachea coronata* FORSK., *Icon. rer. nat.* Tab. 34, fig. A (copied in *Encycl. méth., Vers.* Pl. 88, *Firola*, fig. 1); in the Mediterranean. LESUEUR has given a monograph of this genus in the *Journal of the Philos. Soc. of Philadelphia*, of which BLAINVILLE has made use in the article *Firola*, *Dictionn. des Sc. nat.* Tom. XVII. pp. 62—68. Usually the *tentacula* are wanting. The species in which they are present were united by D'ORBIGNY under the name of *Cerophora*. Here belongs *Firola caudina* RANG, GUÉRIN *Magas. de Zool.* 1832, Cl. V. Pl. 3, GUÉRIN *Iconogr., Moll.* Pl. 11, fig. 3 [For the Anat. and Hist. of Development, see GEGENB. l. l. pp. 153—185, and HUXLEY l. l. *on the Anat. of Firoloïdes* (*Firola*) l. l. pp. 30—36. The auditory vesicle was shewn by LEYDIG *Anatomisch. Bemerkung. üb. Carinaria, Firola und Amphicora Zeitschr. für wissensch. Zool.* III. 1851, p. 328.]

According to D'ORBIGNY the singular genus *Sagitta* (see above, p. 246) should be placed here.

*Carinaria.* Body elongate. Head with two long, subulate tentacles, and two sessile eyes behind the base of tentacles. A small shell at the posterior part of back, thin, pellucid, conical, compressed, with apex turned backward.

These animals have much resemblance to the preceding genus, and CUVIER at first thought that the *Pterotracheæ* described by FORSKÅL had only accidentally lost their shell. *Mémoires, Moll.* No. 18, p. 31. They differ, however, by the constant presence of two tentacles in front of the eyes and by small inequalities or tubercles on the skin.

Sp. *Carinaria cymbium* (*Argonauta Cymbium* L.?) *Ann. des Sc. nat.* XVI. Pl. 1, GUÉRIN *Iconogr., Moll.* Pl. 11, fig. 1, POLI *Testac. utr. Sic.* III. Tab. 44, figs. 1—11; in the Medit. Sea. POLI and DELLE CHIAJE gave an anatomical description of this animal (*Test.* III. pp. 26—35, and *Memorie Sulla Storia e Notom. degli Anim. s. v.*), which was afterwards completed by MILNE EDWARDS as to several remarkable peculiarities, *Ann. des Sc. nat.* sec. Sér. Tom. 18, *Zool.* pp. 323—329, Pl. X. fig. 3, Pl. XI. The remark of LINNÆUS, that the shell is not larger than a grain of sand, does not apply to this species, which therefore has also been often confounded with *Carina vitrea*, a larger species from the Indian Ocean; MARTINI, Tab. 28, fig. 163, BLAINV. *Malac.* Pl. 47, fig. 3 *a*.

*Atlanta* LESUEUR. Head furnished with a proboscis, two cylindrical tentacles, and two eyes. Foot compressed, acuminate towards the end, with a suctorial disc in the margin. Thin operculum, adhering to the ventral part below the foot. Shell very thin, involute, carinate.

Sp. *Atlanta Peronii* LESUEUR, *Corne d'Ammon* LAMANON, *Voyage de* LA PEYROUSE, Pl. 63, figs. 1—3, BLAINV. *Malac.* Pl. 48 bis, fig. 9; *Atlanta Keraudrenii* LESUEUR; this species forms the genus *Ladas* CANTRAINE, *Malacol. méditerr.* Compare on these small animals that occur in the Mediterranean and in warm zones of the Atlantic Ocean, RANG *Mém. de la Soc. d'Hist. nat.* Tom. III. 1827, pp. 372—380, Pl. 9, and D'ORBIGNY *Voyage* (see OKEN'S *Isis*, 1839, pp. 511—519).

B. *Gasteropoda normalia.*

Foot serving for creeping, flattened or grooved.

Section I. In some no distinct organs of respiration, in others naked dorsal branchiæ, appendages or various productions of the common integuments.

We part the common or normal Gasteropods into three divisions, according to their respiratory organs, and unite, as was proposed by the younger LEUCKART, the *Gymnobranchiata* and *Apneusta* under the name of *Dermatobranchiata* of DUMÉRIL; see R. LEUCKART *Ueber Morphologie der wirbell. Thiere*, 1848, s. 178.

Family IV. *Dermatobranchiata* s. *Gymnobranchiata.* Characters of the section. Naked Gasteropods, hermaphrodite, marine, often swimming on the back, with foot supine.

The *Nudibranchiates* (*nudibranches*) of CUVIER have been especially investigated in the latest times. By QUATREFAGES, in many an intestinal canal divided into branches was discovered, or rather a branching appendage of the same, such as we have already noticed in *Distoma*, in some ringed worms, in *Acarina*, in *Phalangium*, &c. These blind branches discharge at the same time the office of liver. (QUATREFAGES gave to this arrangement the name of *Phlebenterismus* (see *Ann. des Sc. nat.*, 3ième Série, Tom. IV. p. 83), which has caused much misconception.) In some it would seem that no heart is present; whilst there are such conflicting opinions on this point, we consider it inexpedient to found an arrangement upon it, which might afterwards be subverted, and therefore cannot adopt the families of *Anangia* and *Angiophora* (V. SIEBOLD *Lehrb. d. vergl. Anat.* I. s. 297). As little do we feel ourselves justified in separating the *Apneusta* from the *Gymnobranchiata*. Those Gasteropods alone can be regarded as *Apneusta*, which, as *Lissosoma*, have no external dermal appendages.

Compare ALDER and HANCOCK in different parts of the *Annals and Magaz. of Nat. Hist.*, and their *Monograph of the British Nudibranchiate*

*Mollusca, with plates, &c.*, published by the Ray Society, London, 1845—1854, six parts, also QUATREFAGES in the *Annales des Sc. nat.* since 1843.

A. *Branchiæ none.*

*Lissosoma* KOELLIKER and QUATREF.

*Limapontia* JOHNST., *Chalidis* QUATREF.

*Actæonia* QUATREF.

*Phyllirhoe* PERON. Body naked, compressed, with two very long, subulate tentacles. (Organs of respiration unknown.)

Comp. PÉRON *Ann. du Mus.* XV. p. 65, Pl. II. figs. 1—3; QUOY et GAIMARD *Voyage de l'Astrolabe, Zoologie,* II. 1833, pp. 403—410, Pl. 28, figs. 10—18; †H. MUELLER und C. GEGENBAUER *Ueber Phyllirhoe bucephalum* in KOELLIKER u. SIEBOLD'S *Zeitschr. f. wissensch. Zool.* V. 1854, pp. 355—371, Taf. XIX. PÉRON placed this animal as well as all the Heteropods amongst the *Pteropoda,* LAMARCK amongst the *Heteropoda,* RANG amongst the *Salpæ.* EYDOUX and SOULEYET from the structure of the animal first removed it to the *Nudibranchiata.* The form of the nervous system, the pouch-like appendages of the intestinal canal, and the disposition of the genital organs, all refer it to this division, although from the compressed form of the body the foot be not distinguishable from the rest of the integument. In the 2nd Edit. of his work VAN DER HOEVEN placed gen. *Phyllirhoe* amongst the Heteropods. He now authorises its removal to this place in the English Translat. of his Handbook. See the Anatomy &c. in the mem. of MUELLER and GEGENB.]

*Cenia* (previously *Ictis*) ALDER and HANCOCK.

*Note.*—Comp. on those genera destitute of branchiæ, the synonymy of which is very obscure, QUATREFAGES *Mém. sur les Gasteropodes phlebentérés, Ann. des Sc. nat.,* 3e Série, I. *Zool.* pp. 129—183, and J. ALDER and HANCOCK *on a proposed new order of Gasteropodous Mollusca, Ann. of Natur. History,* sec. Series, I. 1848, pp. 401—415, Pl. 19, 20. Genus *Pelta* QUATREF. if in reality it agrees with the Mollusc described by the English authors A. and H. (*Ann. of Nat. Hist.* XVIII. 1846, p. 289) cannot be united with these *dermatobranchiata* or *abranchiata.*

*Actæon* OKEN, *Elysia* RISSO, CANTRAINE. Body subcylindrical, limaciform, bordered by a depressed expansion, acuminate posteriorly. Two tentacles auriculate, subclavate, not retractile. Two eyes behind the tentacles. Anus lateral, (sometimes middle, posterior?) on right side.

Sp. *Actæon viridis, Aplysia viridis* MONTAGU, *Linn. Trans.* Tom. VII., QUATREFAGES l. l. Pl. 3, fig. 2. Comp. OKEN *Zool.* I. 1815, p. 307, and especially G. F. ALLMAN *on the Anatomy of Actæon, Annals of Nat. Hist.* Vol. 16, 1845, pp. 145—162, Pl. 5—7.

*Placobranchus* V. Hass.

Comp. Van Hasselt in *Bullet. univ.* De Ferussac, 1824, Oct. p. 249. Scarcely distinct from the preceding genus, with which it is conjoined by Lovén.

B. *Branchiæ external at the sides of back, numerous, tentaculiform.*

† *Vent posterior, in the middle of back.*

*Janus* Verany, *Antiopa* Ald. and Hanc.

Comp. Quatrefages *Ann. des Sc. nat.* 3e Série, xi. 1849, pp. 76—90, Pl. 3, 4. Sp. *Janus Spinolæ, Eolidia cristata* Delle Chiaje. See also *Ann. of Nat. Hist.* sec. Series, i. p. 196.

*Proctonotus* (*Venilia* previously) Ald. and Hanc.

Comp. Alder and Hancock *Annals of Nat. Hist.* 13, 1844, pp. 161—164 and p. 407, Pl. 2. Here also is to be referred as it seems genus *Zephyrina* Quatref. [According to Alder and Hancock the two differ in that four linear tentacles are seen from above in *Zephyrina*, whilst in *Proctonotus* the two larger are dorsal and the smaller arranged at the sides of the velum which covers the head. *Monograph.* No. v. *Procton.*]

†† *Vent lateral, to the right.*

*Alderia* Allman.

Comp. Allman *Ann. of Nat. Hist.* Vol. 17, 1846, pp. 1—5.

*Stiliger* Ehrenb.

*Pterochilus* Alder and Hanc.

*Æolidia* Cuv. (*Æolis* or *Eolis* auctor.). Tentacles four. Angles of foot lateral, the anterior mostly produced. Branchiæ placed at the sides of back, numerous, tentaculiform, emitting stinging filaments at the perforate apex.

Sp. *Æolidia papillosa, Limax papillosus* L., *Syst. nat.*, Baster *Naturk. Uitsp.* i. Tab. x. fig. 1, bl. 93, 94, *Ann. of Nat. Hist.* xv. Pl. i. fig. 1, Alder and Hanc. *Monog.* Pt. vi. Fam. 3, Pl. 9; this little animal attains a length of 2 inches. Comp. Hancock and D. Embleton *on the Anatomy of Eolis, Ann. of Nat. History*, xv. 1845, pp. 1—10, pp. 77—88, sec. Series, i. 1848, pp. 88—105, Frey u. Leuckart *Beitr. z. Kenntniss wirbelloser Thiere*, 1847, s. 54—64. The cœcal branches of the intestinal canal are extended in the *Eolidæ* into the branchial appendages. These appendages have at the point a small vesicle, from whence filaments resembling spermatozoa (nettle-threads, see above, p. 99) come to view. *Ann. of Nat. Hist.* xv. Pl. iv. Pl. v. figs. 1—11.

In the neighbourhood of *Æolidia* some genera or sub-genera of later authors may be placed, all of which cannot be noticed here. *Eolidina*

QUATREF. principally differs by the absence of the lateral prolongations of the foot, which CUVIER regarded as a third pair of tentacles in *Æolidia*. See QUATREFAGES *Ann. des Sc. nat.*, 2e Série, Tom. XIX. *Zoologie*, pp. 271—312, Pl. 11; comp. ALDER and HANCOCK *Annals of Nat. Hist.* XIV. 1844, pp. 125—129.

*Tergipes* CUV. (*Amphorina* QUATREF., and *Psilocerus* MENKE). Branchiæ clavate or obovate, not numerous, placed in a double row. Tentacles four or two.

Sp. *Tergipes lacinulatus*, *Limax Tergipes* FORSK., *Icon. rer. natur.* Tab. XVI. fig. B; *Tergipes psilocerus* nob. L. BOMME, *Verhandel. van het Zeeuwsch Genootsh.* III. 1773, pp. 296—298, Pl. (p. 318) fig. 3; on the sea-wiers of the island of Walcheren. (This little animal certainly does not differ notably from *Amphorina Alberti* QUATR. *Ann. des Sc. nat.*, 3e Série, I. Pl. III. fig. 5, which, however, is smaller.)

Comp. on *Tergipes* A. V. NORDMANN *Versuch einer Monographie von Tergipes Edwardsii*, *Mém. de l'Acad. de St. Petersbourg, savants étrangers*, Tom. IV. 1845, (given in part in *Ann. des Sc. nat.*, 3e Série, V. 1846, pp. 109—160, Pl. I.) The generic name of *Tergipes* rests on an observation that the animal creeps on its back by means of the branchiæ, which is very doubtful.

*Calliopæa* D'ORBIGNY.

Comp. D'ORBIGNY, GUÉRIN *Magas. de Zool.* 1817, *Moll.* Pl. 108; ALDER and HANCOCK *Ann. of Nat. Hist.* XII. p. 233, MILNE EDWARDS *Ann. des Sc. nat.* 2e Série, XVIII. 1843, p. 33, Pl. X. fig. 2.

*Hermæa* LOVÉN.

Comp. *Öfversigt af Kongl. Vetensk. Akad. Förhandl.* 1844, p. 50.

*Cavolina* BRUG.

C. *Branchiæ dorsal, cloven, penicillate or arborescent.*

*Flabellina* CUV.

*Glaucus* FORSTER. Body elongate, posteriorly subulate or filiform. Four short tentacles. Branchiæ digitate or palmate, lateral, three on each side.

Sp. *Glaucus hexapterygius* CUV. *Ann. du Mus.* VI. Pl. 62, fig. 11, pp. 427—430 (*Mém. sur les Moll.* No. 6), *R. Ani., éd. ill.*, Pl. 29, fig. 3; although the figure in BLUMENBACH *Abh. naturh. Gegenst.* No. 48, has eight and not six branchiæ, QUOY and GAIMARD are of opinion that this species denoted as *Glaucus atlanticus* cannot be separated from the preceding, and that only a single species of it is known; comp. *Voyage de l'Astrolabe*, II. pp. 279—283; also G. BENNETT always saw only six branchiæ; he observed that the animal attacked and swallowed *Porpitæ* that were placed in a glass with it. The

colour is purplish or blue and the length nearly 1¾ inches. See *Proceed. Zool. Soc.* 1836, pp. 113—189. These animals are found in the Atlantic Ocean principally between the tropics.

*Scyllæa* L. Body compressed, with foot furrowed longitudinally. Head furnished with two tentacles. Back with two expansions or membranous and flexible wings on each side. Branchiæ penicillate, composed of filaments, scattered over back, especially crowded in the wings.

Sp. *Scyllæa pelagica* L., CUV. *Ann. du Mus.* VI. pp. 416, 417, Pl. 61, figs. 1—7, *Mollusq., Mém.* VI.; BLAINV. *Malac.* Pl. 46, fig. 5; this species attaches itself by its furrowed foot to *Fucus natans*, and is found in the Atlantic ocean; *Scyll. ghomfodensis* observed by FORSKÅL in the Red Sea appears to be the same species. *Descr. Animal.* p. 103, fig., Tab. 39, figs. C. c. Anatomy, ALD. and HANC. *Monogr.* Fam. 2, Pl. 5.

*Dotó* OKEN[1], *Melibea* (or *Melibœa*) RANG. Body limaciform, with foot narrowed posteriorly. Mouth with a circular velum. Two filiform tentacles, defended by an ample cup-shaped sheath. Branchiæ papillose, grouped in muricate clavæ, disposed in a double lateral row on the back. Apertures of generation and of rectum at the right side.

Sp. *Doto coronata, Doris coronata* GMEL. (species of *Tritonia* CUV.), BOMME *Verh. van het Zeeuwsch Genootsch.* I. 1769, Tab. III. bl. 314, *coifed* or *crowned Sea-slug* JOHNSTON, *Ann. of Nat. Hist.* I. p. 117, Pl. 3, figs. 5—8, D'ORBIGNY, GUÉRIN *Magasin de Zool.* 1837, *Mollusq.* Pl. 103, Anatomy in ALD. and HANC. *Monogr.* Fam. 3, Pl. 4.

*Tritonia* CUV. Body subtetragonal or compressed, elongate, anteriorly rotundate, posteriorly acuminate. Apertures of generation and of rectum at the right side, with vent situated behind the genital orifice. Two tentacles retractile into a sheath. Circular velum in front of mouth. Two lateral maxillæ, acute, with margin denticulate. Branchiæ arborescent at the sides of back.

a) *With arborescent branchiæ remote, and sheath of tentacles with margin laciniate.*

*Dendronotus* ALD. and HANC.

Sp. *Tritonia arborescens* CUV., *Doris arborescens* GM., CUV. *Mollusq., Mém.* 6, figs. 8—10 (probably not specifically different from *Doris cervina* GMEL., *the antlered Sea-slug* BOMME, l. l. III. bl. 290, fig. 1). Compare, on the

[1] *Lehrb. der Zoologie*, I. 1815, s. 273.

sound which this little animal produces under water, GRANT *Ann. des Sc. nat.* VIII. pp. 111, 112, and S. REID *Ann. of Nat. Hist.* XVII. p. 389.

b) *With branchiæ disposed in a continuous series; with cup of tentacles entire.*

*Tritonia* ALD. and HANC.

Sp. *Tritonia Hombergii* CUV. *Ann. du Mus.* I. pp. 418—498, Pl. 31, 32, *Moll., Mém.* 4; BLAINV. Pl. 46, figs. 6, &c.

*Polycera* CUV. Body attenuate posteriorly with belly flat, covered by a loose membrane. Dorsal branchiæ in little branches or plumose, covered with membranous laminæ or papillæ. Veil of head running out anteriorly into several cirri or tentaculiform laciniæ. Two clavate tentacles.

*Ægirus* LOVÉN. Tentacles vaginate, simple.

Sp. *Polycera punctilucens* D'ORBIGNY, GUÉRIN *Magasin de Zool.* 1837, *Mollusq.* p. 106.

*Polycera* LOVÉN. Tentacles naked, annulate with transverse lamellæ.

Sp. *Polycera cornuta, Doris cornuta* ABILDGAARD, *Zool. Danica*, Tab. 145, figs. 1—3, BLAINV. *Malac.* Pl. 46, fig. 10; according to LOVÉN *Doris quadrilineata* MUELL. *Zool. Dan.* Tab. 17, figs. 4—6, Tab. 138, figs. 5, 6, and *Polycera ornata* D'ORB., GUERIN *Mag.* l. l. Pl. 107, ought to be brought under the same species. Comp. on this genus ALDER *Annals of Nat. Hist.* VI. 1841, pp. 337—342, Pl. IX., FREY u. LEUCKART *Beitr. zur Kenntniss wirbell. Thiere*, s. 66—70.

*Tethys* L. Body somewhat oblong, depressed, furnished anteriorly with a broad funnel-shaped, fimbriated veil, behind the veil contracted into a species of neck. Mouth proboscidious, retractile, in the bottom of velum. Two conical tentacles at the base of velum, margined by a broad cup-shaped sheath. Apertures of generation and vent at the right side, in the anterior part of body. Two rows of branchiæ at the sides of back; cirrose pectinate branchiæ alternating with smaller bundles.

Sp. *Tethys leporina* L., RONDELET *Pisc.* p. 526, *tertia leporis marini Species*,—CUV. *Ann. du Mus.* XII. pp. 259—270, Pl. 24, *Mém. sur les Moll.* VII., BLAINV. *Malacol.* Pl. 46 bis, fig. 9; in the Mediterranean; the *Teth. fimbria* L., BOHADSCH *De quibusd. Anim. marin.*, Tab. V. figs. 1, 2, appears not to differ from it. DELLE CHIAJE adopts two species, as does LINNÆUS, *Memorie*, III. p. 138, but his *Teth. fimbria* is not that of LINNÆUS, which is distinguished by the absence of filaments at the margin of the *velum*.

*Triopa* JOHNST. (species of *Tritonia* CUV., species of *Euplocamus* PHIL.).

Sp. *Triopa claviger, Doris clavigera* MUELL., *Zool. Dan.* Tab. 17, figs. 1—3; comp. JOHNSTON *Ann. of Nat. Hist.* I. pp. 124, 125, ALDER ibid. XV. pp. 262—264.

*Plocamopherus* LEUCK. (*Plocamoceros* CUV. from typogr. error).

*Ancula* LOVÉN.

*Idalia* LEUCK., *Euplocamus* PHIL.

Comp. LEUCKART *Breves Animal. quorund. Descript.* p. 15, Tab. I. fig. 2, PHILIPPI, WIEGMANN'S *Archiv*, 1839, s. 113—115, Taf. III., *Annals of Nat. Hist.* IV. 1840, pp. 88—90, Pl. III. figs. 1, 2.

*Doris* L., CUV. Body flat or gibbous above, with abdomen flat, covered by a loose membrane, and plicato-marginate. Vent posterior dorsal, in the mid line of body, surrounded by branched or plumed branchiæ disposed in a circle. Apertures of generation at the right side. Tentacles four, two inferior (vestiges of veil) at the proboscidious mouth, two superior retractile within tubes, annulate with transverse lamellæ.

*Doris;* see the critique of CUVIER on this name and on the confusion of this genus by GMELIN and others in *Ann. du Mus.* IV. p. 447 and foll., *Mollusq., Mém.* No. 5.

Compare RAPP *Ueber das Molluskengeschlecht Doris, Nov. Act. Acad. Cæs. Leop. Carol.* XIII. pp. 513—522, Tab. 26, 27, and G. JOHNSTON *Scottish Mollusca nudibranchiata* in *Annals of Nat. Hist.* I. 1838, pp. 50—55, HANCOCK and EMBLETON *on the Anatomy of Doris, Phil. Trans.* 1852, pp. 207—252.

Sp. *Doris Argo* L., BOHADSCH *de quibusd. Animal. mar.* Tab. V. figs. 4, 5, DELLE CHIAJE *Mem.* Tav. 38, figs. 1—7, flat, deep-red above, 3″ long. 2″ broad; in the Mediter.; a flat species of similar size occurs in the North Sea: *Doris tuberculata* CUV., JOHNST., ALD. and HAND. *Monogr.* Fam. I. Pl. 3; *Doris stellata* GMEL., BOMME *Verh. van het Zeeuwsch Genootsch.* III. p. 318, fig. 4 (does it differ from *Doris tomentosa* CUV., *D. pilosa* JOHNST.?)

*Note.*—Add some genera of modern writers, *Villiersia* D'ORBIGNY, *Onchidora* BLAINV., *Goniodoris* FORBES.

Section II. Organs of respiration branchiæ, included in mantle, or covered by free margin of mantle.

Family V. *Hypobranchiata.* Naked gasteropods, hermaphrodite, marine. Branchial lamellæ situated on each side in a furrow between the mantle and foot, transverse, in a single row.

The heart lies in these molluscs in the middle of the body on the dorsal surface, and receives the blood from the gills placed on each side. MILNE EDWARDS unites this family with the preceding and the next following into a common order under the name of *Opisthobranchia*. This family approaches, however, very near to the preceding, and especially to the genera *Doris* and *Tritonia*.

*Phyllidia* CUV. Head with four tentacles, the two superior retractile within a cavity. Anus in posterior and middle part of back.

Comp. CUVIER *Ann. du Mus.* v. pp. 266—276, Pl. XVIII. *Mollusq., Mém.* VIII.

Sp. *Phyllidia trilineata* CUV., *Phyll. varicosa* LAM., CUV. l. c. figs. 1—6, BLAINV. *Malac.* Pl. 47, fig. 1; in the Indian and Red Seas, as also *Phyllidia pustulosa* CUV. ibid. fig. 8, LEUCKART *in Atlas zu der Reize von* E. RUEPPELL, *Wirbellose Thiere des rothen Meeres*, p. 36, Tab. XI. fig. 1.

*Pleurophyllidia* MECK., *Diphyllidia* CUV., *Armina* RAFIN. (on the authority of CANTRAINE), *Linguella* BLAINV. Head with two tentacles placed towards the back at the anterior margin of mantle. Frontal veil with angle produced on each side. Vent in right side, behind genital foramen. Mantle acuminate posteriorly.

Sp. *Pleurophyllidia lineata, Diphyll. lineata* OTTO, *Nov. Act. Acad. Cæs. Nat. Cur.* XVII.; DELLE CHIAJE *Memorie*, I. p. 128, Tab. 10, figs. 12—20; MECKEL *Archiv f. d. Physiol.* VIII. 1823, Taf. II. figs. 1—7, s. 190—207, CANTRAINE *Malac. mediterr.* p. 63, Pl. 2, fig. 4, in the Mediter. and according to LOVÉN in the North Sea also. *Diphyll. verrucosa* CANTR. ibid. fig. 3. Comp. *Diphyll. ocellata* DESH., *R. Ani., éd. ill., Moll.* Pl. 31, fig. 2. (The specimen from the collection of BRUGMANS, on which CUVIER founded this genus, now in the *Rijks Museum* of Leyden, *Diphyll. Brugmansii* CUV., is of one colour, pale and with a smooth mantle.)

Family VI. *Pleurobranchiata*. Marine gasteropods hermaphrodite, naked or furnished with a small internal shell, more rarely external. Branchiæ composed of divided laminæ resembling leaves pinnatifid or supradecomposed, on one side only, where are also the vent and orifices of generation, mostly situated on the right side or backwards on the back, more or less covered by the mantle.

This family, named by CUVIER *Tectibranches*, which was translated by many writers *Pomatobranchia*, by MENKE *Crypsibranchia*, has no greater claim to this name, or even less than many other divisions of molluscs. We adopt therefore the name of *Pleurobranchiata* instead of the *sesquipedale* of BLAINVILLE *Monopleurobranchiata*

received by us in the first edition of this Handbook, II. bl. 89. We see that in this we have been anticipated by GRAY and REEVE.

*Umbrella* LAM. (*Gastroplax* BLAINV.).

*Pleurobranchus* CUV. Body with flat abdomen, a furrow between the mantle and abdomen receiving the branchiæ on the right side. Mantle covering the whole of back. Velum in front of mouth acuminate on each side. Two tubular tentacles fissured by an external furrow. Vent behind branchia in right side. Shell dorsal, contained in mantle, horny or calcareous.

Comp. on this genus CUVIER *Ann. du Mus.* v. p. 266 and foll. Pl. VIII. *Mollusq., Mém.* VIII.

Sp. *Pleurobr. Peronii* CUV., l. l. figs. 1, 2, *R. Ani., éd. ill., Moll.* Pl. 32, fig. 1; from the Indian Sea;—*Pleurobr. Forskalii* LEUCK., FORSK. *Icon. Rer. natural.* Tab. 28, fig. A, *Lepus marinus* RUEPPELL, *Atlas* l. l. Tab. 5, fig. 2; in the Red Sea;—*Pleur. testudinarius* CANTR., *Pleur. Forskalii* DELLE CHIAJE, *Memorie,* Pl. 41, fig. 11; from the Mediter. &c. Comp. CANTRAINE *Malac. méd.* pp. 87—90.

*Pleurobranchœa* MECK., *Pleurobranchidium* BLAINV. Four tentaculiform laciniæ, not retractile. Vent above branchia in the right side. Shell none. Mantle shorter than body.

Sp. *Pleurobranchœa Meckelii* CUV., DELLE CHIAJE *Memorie,* Pl. 40, fig. 11, CANTRAINE l. l. Pl. III. fig. 3; from the Mediterr. Sea. Comp. S. F. LEUE *Diss. de Pleurobranchœa.* Halæ, 1813, c. fig.

*Aplysia* L., GMEL. (*Laplysia* L., typogr. error, LAM.). Body oblong, limaciform, mostly margined by a broad velum reflected over the back. Two contractile tentacles, conical, sulcated, in the upper part of head; two productions of the velum surrounding the mouth, forming as it were a second pair of inferior tentacles. Eyes sessile in front of base of superior tentacles. Branchiæ dorsal, covered by a production of mantle, with an operculum including a flat membranoso-corneous or calcareous shell.

Comp. SANDER RANG *Hist. nat. des Aplysies.* Paris, 1828, fol.

*Dolabella* LAM. Operculum of branchiæ towards the posterior part of back, including a calcareous shell. Body mostly truncated posteriorly with an orbicular declining area.

Sp. *Aplysia Rumphii* RANG, *Dolabella Rumphii* CUV., RUMPH. *Amb. Rariteitk.* Tab. X. fig. 5 (Tab. XL. fig. N the shell); CUV. *Ann. du Mus.* v. p. 437 and foll., Pl. 39, figs. 1—4, *Moll., Mém.* 12, RANG l. l. Pl. 1.

*Aplysia auctor.* Body elongate, not truncated posteriorly, angustate. Dorsal operculum of branchiæ including a membranous horny shell.

Comp. BOHADSCH *De quibusd. animalib. marinis,* pp. 1—53, Tab. I.—IV. CUVIER *Ann. du Mus.* II. pp. 287—314, Pl. II. *Mollusq., Mém.* IX.; DELLE CHIAJE *Memorie,* I. pp. 25—76, Tab. II.—V.

These animals, on a first impression, resemble gigantic slugs (*Limaces*). The ear-shaped tentacles have given occasion to stamp this genus with the name of *Sea-hare* (*Lepus marinus*). They live on *fuci;* and shed a purple fluid at the margin of the mantle.

Sp. *Aplysia depilans* L., BOHADSCH l. l. Tab. I.—IV. RANG l. l. Pl. 16, CUVIER *R. Ani., éd. ill., Moll.* Pl. 33; one of the largest species; of this Mediterranean species, under the name of *Lernæa,* BOHADSCH gave l. cit. a detailed description and a masterly anatomical investigation. In that and in other seas still different species of this genus are found. The eggs are laid in long tortuous strings. The development of *Aplysia* has been observed by VAN BENEDEN, *Ann. des Sc. nat.* 2e Série, XV. pp. 123—128, Pl. I.

*Notarchus* CUV.

*Bursatella* BLAINV.

*Note.*—RANG l. l. concludes that these genera form sections only of the great genus *Aplysia.* Of *Notarchus* the same has been noted by the celebrated voyagers QUOY and GAIMARD, *Voyage de l'Astrolabe, Zoologie,* II. p. 312.

*Gastropteron* MECK. Tentacles none. Margins of foot expanded into ample wings. Shell none. Branchiæ pectinate, almost entirely naked; a small duplicature of mantle, produced beyond the body into a filiform lacinia.

Sp. *Gastropteron Meckelii* J. F. J. KOSSE, *Diss. de Pteropodum ordine et novo ipsius genere,* Halæ, 1813, 4to, figs. 11—18, *Clio Amati* DELLE CHIAJE, *Memorie,* pp. 53—59, Tab. II. figs. 1—8; CANTRAINE l. l. Pl. 4, fig. 4; a small mollusc from the Medit. Sea, of a rose-red colour; the only species hitherto known.

*Acera* MUELLER (in part), LAM. (*Doridium* MECK., *Lobaria* BLAINV.). Tentacles none. Veil of head large, separated from mantle by a transverse furrow. Vent, orifice of generation, branchiæ and heart placed at the right side; branchiæ posterior. A small shell included in the posterior part of mantle, flat, calcareous at the incurved apex, elsewhere membranous, thin.

Comp. on this and the two following genera CUVIER *Ann. du Mus.* XVI. pp. 1—18, *Mollusq., Mém.* X.

Sp. *Acera carnosa* Cuv., *Ann. du Mus.* l. l. p. 10, Pl. 1. figs. 15—19, *Mém. s. l. Moll.* l. l. Pl. 2, figs. 15—19, *R. Ani., éd. ill., Moll.* Pl. 35, fig. 2. See on another species from the Mediterranean, Cantraine op. cit. pp. 73, 74.

*Bulla* L. (in part), Brug. Velum of head large, separated from mantle by a transverse furrow, in some produced into four laciniæ or tentaculiform appendages. Vent, orifice of generation, branchiæ and heart placed at the right side. Foot shorter than body, with lateral margin produced, undulato-plicate. Shell thin, convolute, with aperture large.

*Bullæa* Lam. (*Philine* Ascan., *Lobaria* Muell., Gmel., species of *Bulla* L.). Shell very thin, concealed, not affixed by muscles, with very wide aperture, and lip alone slightly involute.

Sp. *Bulla aperta* L., Gm. (in part), *Lobaria quadriloba* Muell., Gmel., Mueller *Zool. Danic.* Tab. 100, figs. 1—5, Cuv. *R. Ani., éd. ill., Moll.*, Pl. 35, fig. 1; in the Mediterranean and North Sea.

*Bulla* Lam. (*Scaphander* Montf., *Alicula* Ehrenb., &c.) Shell external affixed by muscles, involute, with spire little exsert or depressed.

Sp. *Bulla ampulla* L., Rumph. *Amb. Rariteitk.* Tab. 27, fig. G, Blainv. *Malacol.* Pl. 45, fig. 12;—the apex is somewhat projecting in *Bulla Aplustre* (*Bulla Amplustre* L.), *Encycl. méth., Vers.* Pl. 359, fig. 2, Blainv. *Malac.* l. l. fig. 10, &c. There are also fossil species of this genus, almost all from the tertiary formations.

*Note.—Posterobranchæa* D'Orbigny. A genus related to the *Aceræ*, shell none, but differing from its congeners by the branchiæ placed on the *left side.*

Sp. *Posterobr. maculata* D'Orbigny, *Voyage dans l'Amér. mérid.* (reprinted in Oken's *Isis*, 1839, pp. 526, 527; comp. also Troschel, Wiegm. *Archiv*, 1838, II. p. 282).

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The new genera *Lobiger* and *Lophocerus* Krohn, if indeed they belong to this family, must as it seems be placed near *Aplysia.*

Comp. Krohn, *sur deux nouveaux genres de Gastéropodes, Ann. des Sc. nat.* 3e Série, VII. pp. 52—60, Pl. II.

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Family VII. *Cyclobranchiata.* Gasteropods with branchiæ foliaceous or pyramidal, arranged in rows on each side under the margin of mantle. Sexual organs without organs of copulation.

Sexes distinct. Tongue long, linear, mostly beset densely with teeth and barbs. Shell resembling a shield, dorsal, not turbinated, with aperture ample.

The position of the branchiæ brings this family into the neighbourhood of the *Hypobranchiata*, and thus LAMARCK refers *Patella* and *Chiton* with *Phyllidia* to the same family. In other respects, however, there exists much difference amongst these animals, as at once appears from the disposition of the sexual organs, since in this division the sexes are distinct. Still, in a natural sequence of the animal kingdom, the *Cyclobranchiata* ought to form as it were the transition of the *Ctenobranchiata* to the three preceding families, the *Opisthobranchiata* of MILNE EDWARDS.

That some individuals of *Patella* are female, others male, was observed by GRAY (*Annals of Nat. Hist.* I. p. 482), by MILNE EDWARDS (*Annales des Sc. nat.*, 2e Série, XIII. p. 376), by PETERS and ROBIN (MUELLER'S *Archiv*, 1846, s. 134) and by WAGNER (besides in *Patella*) also in *Chiton* (*Annals of Nat. Hist.* VI. p. 70).

*Chiton* L. Shell multivalve, made up of (eight) testaceous scales arranged in a longitudinal row, incumbent on back. Mantle at the circumference not covered by shell, with margins hard, coriaceous, often aculeate or squamose. Ventral disc elongate, narrower than body. Eyes and tentacles none; head crested by a wavy veil.

With LINNÆUS there are three genera of *Testacea multivalvia*: *Chiton*, *Lepas* and *Pholas*. The last genus belongs to the *Conchifera* or *Bivalvia*; *Lepas* is, as we stated above, a family of the *Crustacea*. Thus there remains the genus *Chiton* alone as a true multivalve mollusc. That it has no affinity or true similarity with the *Cirripedia* (*Lepas* L.), to which BLAINVILLE united it under the name of *Malacoëntoma*, now requires no demonstration; but many authors, both of earlier and later periods, still maintain that it differs too remarkably from the rest of the Gasteropods to allow it to remain in the neighbourhood of *Patella*, and that it forms the transition to the ringed worms (MILNE EDWARDS *Ann. des Sc. nat.*, 3e Série, IX. 1848, p. 110). It appears to us that these writers attach too much weight to the external resemblance of the pieces of shell to rings of articulate animals. In the internal structure there is, perhaps, with the exception of the remarkable occurrence of two oviducts (or *vasa deferentia*), and two sexual apertures placed at the side, nothing to be met with that can indicate a remote affinity with the *Articulata*.

Compare for the Anatomy of *Chiton*, POLI *Testac. utr. Sic.* I. *Multivalv.* pp. 1—10, Tab. III.; CUVIER *Mém. pour servir à l'Hist. nat. et à l'Anat. des Mollusq.* No. 18, pp. 22—28, Pl. III. figs. 8—14, and A. TH. MIDDENDORFF *Beschreibung u. Anatomie neuer Chitonen, Mém. de l'Acad. impér. des Sc. de St. Pétersbourg*, 6e Série, Tom. VI. 1848, pp. 67—215, av. 14 pl.

The species of this genus are very numerous and difficult to distinguish otherwise than by accurate measurements of the comparative length and breadth, the greater or lesser inequality &c. of the pieces of shell, and by the nature of the margins of the mantle which are not covered by the dorsal shields. In some species these margins of the mantle cover, as though they came together by continued growth, the dorsal shields, so that the shell is concealed within them. Of these MIDDENDORFF forms the sub-genus *Cryptochiton* (Sp. *Cryptochiton Stelleri* MIDDEND. l. l. Taf. I. figs. 1, 2, *Chiton amiculatus* SOWERBY, *Conchol. Illustrations, Chitones*, fig. 80, REEVE *Conchologia system.* II. Pl. 132, 133, fig. 80; from which *Chiton amiculatus* PALL., according to MIDDEND., does not differ). The remaining species form the sub-genus *Phœnochiton* MIDDEND., in which the branchiæ are sometimes situated backwards and the row of pieces of shell is interrupted by the mantle (*Dichachiton* MIDDEND., *Chitonellus* LAM., Sp. *Chitonellus lævis* LAM., BLAINV. *Malac.* Pl. 87, fig. 5); or the pieces of shell close upon one another and the branchiæ are placed round about at the sides of the mantle (*Hamachiton* MIDDEND.) To this last division belong most of the species of the genus *Chiton* of LAMARCK. On account of its size we notice *Chiton gigas* SPENGL., CHEMN. *Conchyl.* Tab. 96, fig. 819, *Encycl. méth., Vers.* Pl. 161, fig. 3 (figured in the young state by F. KRAUSS *Südafrik. Mollusk.* Tab. III. fig. 3).

Compare also on the species of the genus *Chiton*, SPENGLER *Skrivter af naturh. Selskabet*, IV. 1, 1797, pp. 62—103, Tab. 6, and J. E. GRAY *Annals of Nat. Hist.* XX. 1847, p. 131 and foll.

*Patella* L. (exclusive of several species). Shell univalve, covering body entirely above, clypeate or retuso-conical. Branchiæ placed under the margin of mantle, lamellose, lateral, disposed in a series surrounding the body. Head with two tentacles acuminate, bearing the eyes externally at their base.

*Limpets.* A very numerous genus of molluscs. The intestinal canal which, as in the preceding genus, is very long and forms many convolutions runs with the rectum upwards, so that the vent is placed under the head on the right side, whilst in *Chiton* it lies in the mid line at the posterior extremity of the body. The nervous system presents a band lying transversely upon the œsophagus and swelling on each side into a ganglion, from which the nerves for the eyes, the feelers and the neighbouring parts arise. Two nervous filaments descend on each side and form a transverse ganglion, from which nerves arise for the foot, the viscera and the circular muscle that attaches the animal firmly to its shell. Compare CUVIER *Mém. sur les Mollusq.* No. 18, pp. 15—19, Pl. II. figs. 8—19, and the fig. of *Patella algira* DESH. in CUV. *R. Ani., éd. ill., Moll.* Pl. 66.

Sp. *Patella vulgata* L., BLAINV. *Malacol.* Pl. 48, fig. 1, Pl. 49, fig. 1; *Patella granatina* L., LISTER *Conchyl.* Tab. 534, fig. 13;—*Patella compressa* L., LISTER, Tab. 541, fig. 25, BLAINV. Pl. 49, fig. 2, &c.

*Appendix to the Cyclobranchiata.*

*Nematobranchia* MENKE (*Cirrobranchiata* BLAINV.). (An abnormal, aberrant, family.)

*Dentalium* L. Shell tubular, elongato-conical, subarcuate, pervious at both extremities, with posterior aperture narrow, a fissure often extending upon the shell. Animal conical, eyes none, branchiæ composed of many cirri arranged in two fasciculi.

The genus *Dentalium*, placed by LINNÆUS with *Patella*, and referred by later writers to the ringed worms, belongs in reality, according to the investigations of SAVIGNY and DESHAYES, to the *Mollusca*, although it is difficult to unite that genus with any of the other families. It forms a small group between the *Heteropoda* and *Aspidobranchiata* (*Emarginula*). The species are numerous; many are extinct, and occur in various tertiary and secondary formations.

Sp. *Dentalium elephantinum* L., MARTINI *Conchyl.* Tab. 1. fig. 4 A, DESH. (see below) Pl. XVII. fig. 7;—*Dent. Entalis* L., DESH. Pl. XV. fig. 7, XVI. fig. 2, GUÉRIN *Iconogr., Annel.* Pl. 3, fig. 1, CUV. *R. Ani., éd. ill., Annel.* Pl. 7, &c.

Comp. on this genus DESHAYES *Anatomie et Monographie du genre Dentale, Mém. de la Soc. d'Hist. nat.* II. Paris, 1825, pp. 321—378, Pl. 15—18.

Family VIII. *Aspidobranchiata.* Shell clypeiform, in most not turbinate, with very large aperture, incumbent on the pectinate branchiæ. Heart with two auricles, perforated by the rectum as in *Acephala*. Organs of sex distinct, some individuals male, others female.

*Lottia* GRAY (*Patelloïde* QUOY and GAIM.). Branchia pectinate, placed on the right side and forwards, often emerging beyond the mantle. Shell conical, often thin.

*Note.*—A genus very similar to the *Patellæ*, but different in the structure of the branchiæ. Comp. QUOY et GAIMARD *Voyage de l'Astrolabe, Zoologie*, III. 1834, pp. 349—366. Sp. *Lottia testudinaria, Patella testudinaria* L., LAM.;—*Patella virginea* MUELL., *Lottia pulchella* FORBES. Comp. ALDER *Ann. of Nat. Hist.* VIII. 1841, pp. 404—406.

*Parmophorus* LAM. Shell oblong, oval, depressed, clypeiform, not turbinate, with margin entire, apex subincurved, not perforate.

Mantle with margin reflected, covering the circumference of shell. Tentacles thick, conical, bearing the eyes externally at the base.

Sp. *Parmophorus australis* BLAINV., *Malacol.* Pl. 48, fig. 2, CUVIER *R. Ani., éd. ill., Moll.* Pl. 65, &c.

*Emarginula* LAM. Shell scutellato-conical, anteriorly emarginate. Mantle furnished with a single row of tentacles at the margin of foot, incised anteriorly, under the emarginate part of shell. Eyes set on tubercles at the base of tentacles.

Comp. CUVIER *Mém. sur les Mollusques*, No. 18, pp. 14, 15, Pl. II. figs. 3—7.

Sp. *Emarg. fissura* LAM., *Patella fissura* L., MUELLER *Zool. Danic.* Tab. 24, figs. 7—9.

Of this genus, as of the preceding, fossil species are found. See LAMARCK *Ann. du Mus.* I. pp. 383, 384; VI. Pl. XLIII. figs. 5, 6.

*Fissurella* BRUG. Shell clypeiform, with vertex perforate. Sides of foot margined by mantle, rugose, without tentacles. Mantle with an oval aperture on the back, corresponding to the perforation of the shell, leading to the branchial cavity. Anus placed below the fissure of mantle. Eyes sessile, placed externally at the base of tentacles.

CUVIER *Mollusq.* l. l. pp. 12—14, Pl. II. figs. 1, 2.

Sp. *Fissurella græca, Patella græca* L., BLAINV. *Malacol.* Pl. 48, fig. 3, &c. This genus also is met with fossil; see LAMARCK *Ann. du Mus.* I. p. 312. The fossil species are principally from the tertiary formations, some from the Chalk-period.

*Haliotis* L. Shell depressed, auriform, with aperture very ample, spire very short. Head with two very long tentacles, and two oculiferous tubercles behind the tentacles. Branchial cavity placed to the left, including two lamellose pectinate branchiæ.

Sub-genus *Stomatia* HELBLING, with addition of *Stomatella* LAM. Shell imperforate, with spire prominent.

Sp. *Haliotis imperforata* CHEMN., GM., *Stomatia phymotis* HELBL., MEUSCHEN *Naturforscher*, XVIII. 1782, pp. 19, 20, Tab. II. fig. 18, BLAINV. *Malacol.* Pl. 49 bis, fig. 4.

Sub-genus: *Haliotis* LAM. Shell perforate by a row of foramina near the left margin, pearly within.

*Sea-ears.* Feelers pass through the holes of the shell. These holes are closed up in the hinder part of the shell as the animal grows, and at the same time new ones are formed more forwards.

In front, in the margin, an excision is seen in the direction of the holes, which afterwards, during the growth, becomes changed into a hole. The ventral disc or foot is adorned with a double row of feelers, tubercles, and fringes. The animal is attached to the shell by a large oval muscle. The branchial cavity opens by a fissure of the mantle on the right side, under the foremost holes of the shell.

Comp. CUVIER *Mollusq.* l. l. pp. 6—12, Pl. 1. figs. 9—17.

Sp. *Haliotis parva* L., *Hal. canaliculata* LAM., GUÉRIN *Iconogr., Moll.* Pl. 23, fig. 1; *Haliotis Midæ* L., LISTER *Conchyl.* Tab. 613, fig. 5, &c.

Many species of *Haliotis* bear a great resemblance to each other, and are difficult to distinguish. Some fossil specimens of this genus are met with in the tertiary formations.

Family IX. *Aulobranchiata.* Shell irregular, tubular, with turns twisted spirally at the apex. Branchiæ pectinate. Sexes separate.

*Siliquaria* BRUG. Shell thin, tubular, loosely spired; aperture rotundate, emarginate, with an incisure running with the spires to a short distance from the apex. Mantle cloven in the same part; pectinate branchiæ placed at the fissure of mantle.

Sp. *Siliquaria anguina* LAM., *Serpula anguina* L., BLAINV. *Malacol., Principes,* Pl. 1. fig. 11.

*Magilus* MONTFORT.

Comp. E. RUEPPELL *Mémoire sur le Magilus antiquus* MONTF.; *Mémoires de la Soc. d'Hist. nat. de Strasbourg,* Tom. 1. Livr. 2, 1833, av. fig. According to RUEP. this animal belongs rather to the pectinibranchiate molluscs than to this family; it lives in the Red Sea inclosed in cavities of *Meandrinæ.*

*Vermetus* ADANSON. Shell thin, tubular, loosely spired, with spire adhering at the apex, elsewhere loose. Aperture orbicular, with margins connected. Head with two tentacles, oculiferous externally at the base. Appendage of body replicate downwards, mostly furnished with an operculum. Branchiæ arranged in a conical series, at the left side of respiratory cavity.

Sp. *Vermetus lumbricalis, Serpula lumbricalis* L., BLAINV. *Malacol.* Pl. XXXIV. fig. 1, &c.

Family X. *Ctenobranchiata.* Shell spirate or conical. Branchial cavity contained in the last turn of shell, open externally by a large fissure between body and margin of mantle, containing

three branchiæ, two or a single one, composed of numerous leaves, arranged parallel like the teeth of a comb.

Very rarely in place of branchiæ a vascular network in the walls of respiratory cavity. Sexes separate, external organs of copulation distinct.

*Pectinibranchiates.* In all two feelers and two eyes are present; these last are often pediculate. The mouth has the form of a proboscis, of which the structure has been described at length by CUVIER in the whelk (*Buccinum*). It consists of two tubes, which push one into the other and are connected together by the upper margin, so that when the innermost tube is unrolled and elongated, the outermost becomes shorter. This instrument is moved by many muscles[1]. The hinder part of the body contains the liver and the sexual organs. The sexes are distinct. In the male the penis is situated on the right side, behind the head, and in some, as in the whelk, is very large. It is folded round and concealed in the respiratory cavity, but is not retracted within the body, except in the genus *Paludina*, where it is protruded and retracted through an aperture in the right tentacle, which had been observed already by LISTER, but was afterwards incorrectly denied by DRAPARNAUD. Through the penis runs a tortuous canal, which on copulation, when that organ is erected, probably loses its tortuosities. According to BASTER and BLAINVILLE, the shells indicate a difference of sex, and those of the female are wider, particularly in the last wreath[2].

The females secrete a kind of common envelope for the eggs, which they deposit at the same time with the eggs. On our shores round clumps of yellow vesicles may be frequently observed, which resemble bunches of grapes, and are the masses of whelk's eggs in question[3]. According to CUVIER, this envelope is secreted by a

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[1] *Ann. du Mus.* XI. 1808, *Mémoires s. l. Moll.* No. 17, pp. 6, 7, figs. 8—10.

[2] See BASTER *Natuurk. Uitsp.* I. bl. 39, 40; BLAINV. *Journal de Physique*, XCIV. p. 92; MECKEL'S *Archiv f. d. Physiol.* VII. s. 571—573, 1822. BASTER says that in *Buccinum* the shell of the male is somewhat smaller, that it has a greater number of wreaths, but which are thinner than those of the female.

[3] See figures of them in BASTER *Natuurk. Uitsp.* I. Tab. V. figs. 2, 3 of *Buccinum undatum;* Tab. VI. figs. 1—3, of a species of *Murex*. Comp. ibid. bl. 38—45; see also LUND *Recherches sur les Enveloppes d'œufs des Gastéropodes pectinibranches, Ann. des Sc. nat.*, 2e Série, I. *Zoologie*, pp. 84—112. By ARISTOTELES these masses of eggs are called μελικήραι (translated *favagines*); he did not, however, suppose that shelled

lamellate or cellular organ situated in the respiratory cavity near the gills, and of which the interspaces are filled by a slimy fluid. This organ, however, occurs in the male, although less developed[1].

Phalanx I. *Capuloïdea.* Shell conical or orbicular, scarcely turbinate. Aperture very large, without any sinus or canal. Operculum in some none, in others subinternal.

*Sigaretus* ADANS., *Cryptostoma* BLAINV. Shell orbicular or oblong, auriform, concealed under the foot reflected towards the back. Aperture ample, entire, with labium effuse, dilate, patent. Cavity of branchiæ furnished with a semicanal, in connexion with an incisure of mantle, and containing two pectinate branchiæ. Head with two tentacles depressed, conical, furnished with a tubercle at the base. (Eyes none?)

Sp. *Sigaretus haliotoïdeus* LAM., *Helix haliotoïdea* L., RUMPH. *Amb. Rariteitk.* Tab. 40, fig. R, ADANSON *Coquill.* Pl. 2, fig. 2, &c. This genus is allied to *Natica* in the following division.

*Coriocella* BLAINV. (*Sigaretus* CUV., *Lamellaria* MONTAGU, LOVÉN. Shell with aperture ample, auriform, thin, horny, concealed under mantle. Two eyes at the base of tentacles. Tongue armed with barbs, very long, spirally convolute.

Comp. CUV. *Mém. s. l. Mollusq.* No. 18, pp. 2—6, Pl. 1. figs. 1—8.

Sp. *Sigaretus Tonganus* QUOY and GAIM., *Astrolabe, Zool.* II. p. 217, CUV. *R. Ani., éd. ill., Moll.* Pl. 49, fig. 2, &c.

*Siphonaria* SOW.

Is this its place? Comp. BLAINV. *Dict. des Sc. nat.* Tom. 32, p. 267, *Malacol.* p. 475, REEVE *Conchol. syst.* II. pp. 19, 20, MICHELIN in GUÉRIN *Magas. de Zool.* 1831, 1832.

*Calyptræa* LAM. (and *Crepidula* ejusd.). Shell with aperture ample, orbicular or oblong, convex on the back. Branchial series single, of filaments often very long. Tentacles triangular; eyes at the base of tentacles towards the outside.

*Calyptræa* LAM. Shell conoid with base orbicular. A calcareous lamina, conical or spiral, in the cavity of shell, and adhering to its apex.

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animals proceeded from them, but imagined, according to the notions then prevalent, that these originated from slime and putrefaction. *De Hist. Animal.* v. c. 15 *initio.*

[1] CUVIER *Mém. sur les Mollusq.* l. l. p. 5, and fig. 3 *f.*

Sp. *Calyptræa equestris* LAM., *Patella equestris* L., RUMPH. *Amb. Rariteitk.* Tab. 40, figs. P, Q; D'ARGENV. Pl. 2, fig. K, BLAINV. *Malacol.* Pl. 49 bis, fig. 2; habitat Indian Ocean. Comp. on this genus DESHAYES *Mémoire sur la Calyptrée, Ann. des Sc. nat.* III. 1824, pp. 335—344; BRODERIP *Descriptions of some new spec. of Calyptræidea, Transact. of the Zool. Soc.* I. 3, 1835, pp. 195—206, Pl. 27—29; OWEN *On the Anatomy of Calyptræidæ*, ibid. pp. 207—212, Pl. 30.

Sub-genera: *Calypeopsis* LESS., *Zool., Coq.* p. 399, *Illustr. de Zool.* Pl. 2; *Lithedaphus* OWEN (with calcareous lamina, affixed by its base).—Comp. REEVE *Conch. syst.* II. pp. 31, 32.

*Crepidula* LAM. Shell ovate or oblong, with apex incurved, inclined towards margin. Aperture partly closed by a horizontal lamina.

Comp. CUVIER *Mollusq., Mém.* 18, pp. 20, 21, Pl. III. figs. 3—7.

Sp. *Crepidula porcellana* LAM., *Patella porcellana* L., RUMPH. *Amb. Rariteitk.* Tab. 40, fig. O; BLAINV. *Malacol.* Pl. 49 bis, fig. 3, &c.

Sub-genus *Crepipatella* LESS., *Zool., Coq., Ill. de Zool.* Pl. 42.

*Capulus* MONTFORT, *Pileopsis* LAM. Shell obliquely conical, with apex incurved backwards. Animal with long proboscis, deeply chanelled above. Eyes set on tubercles or petioles at the outside of tentacles. Neck furnished beneath with a folded velum. Branchial series single, composed of narrow laminæ.

Comp. CUVIER l. l. pp. 19, 20, Pl. III. figs. 1, 2.

Sp. *Capulus hungaricus, Patella ungarica* L., D'ARGENV. Pl. 2, fig. 3, CUV. *R. Ani., éd. ill., Moll.* Pl. 47, fig. 7, &c.

*Hipponyx* DEFR. With lamina basal, calcareous.

Sp. *Capulus cornucopiæ, Pileopsis cornu copiæ* LAM., BLAINV. *Malac.* Pl. 50, fig. 1, BRONN *Leth. geogn.* Tab. 40, fig. 12; fossil in the *calcaire grossier.* This sub-genus is related to *Capulus* as *Lithedaphus* is to *Calyptræa.* Some species still living are known, and some others fossil, all from the tertiary formations.

Phalanx II. *Trochoïdea.* Shell spiral, with aperture entire, not canaliferous; animal mostly furnished with an operculum.

*Pileolus* COOKSON, SOWERBY.

Comp. DESHAYES *Encycl. méth., Vers.* III. p. 764. Fossil genus.

*Navicella* LAM., *Septaria* FERUSS. Shell elliptical, or oblong, convex above, concave below, with apex subspiral inflected as far as the margin. Labium flattened, narrow, transverse. Operculum concealed, flat, irregular, at the upper part of foot. Animal with

long tentacles not retractile, and eyes petiolate at the outside of tentacles.

Sp. *Navicella elliptica* LAM. (*Patella neritoïdea* L.?), MEUSCHEN *Naturforscher*, XII. Tab. 5, fig. 1, *Encycl. méth., Vers.* Pl. 456, fig. 1, BLAINV. *Malacol.* Pl. 36 bis, fig. 1, Pl. 48, fig. 5, &c.; fresh-water molluscs from the tropical regions.

*Nerita* L. (in part). Shell spiral, planato-ovate or semiglobose, imperforate. Aperture semiorbicular, with columellar margin or labium dilate, transverse, truncate. Foot of animal broad, furnished with operculum; eyes set on petioles or tubercles at the base of tentacles, towards the outside.

* Fluviatile species, with shell mostly thinner and lip edentulous. *Neritina* LAM.

Sp. *Nerita fluviatilis* L., SWAMMERDAM *Bibl. nat.* Tab. X. fig. 2, PFEIFFER *Land- und Wasserschn.* I. Tab. 4, figs. 37—39, &c.

* * Marine species, with shell thicker and lip often dentate. *Nerita* LAM.

Sp. *Nerita Peloronta* L., *Encycl. méth., Vers.* Pl. 454, fig. 2, BLAINV. *Malac.* Pl. 36 bis, fig. 6, &c. Species many, some fossil.

*Narica* RECLUZ (species of *Sigaretus* LAM.), *Merrya* GRAY. Shell subglobose, umbilicate, with short spire. Aperture ample, semiorbicular. Operculum horny. Head proboscideous; two triangular tentacles bearing very small eyes externally at the base. Single branchia, with triangular leaflets, contained in a large respiratory cavity.

Sp. *Nar. cancellata* RECLUZ, *Sigaretus cancellatus* LAM., RECLUZ, GUÉRIN *Magas. de Zool.* 1845, *Moll.* Pl. 119. Comp. on this and other species of this genus, all of which live in the sea, RECLUZ op. cit.

*Velutina* GRAY, BLAINV.

Sp. *Velutina haliotoïdea, Bulla velutina* MUELL. *Zool. Danic.* Tab. 101, figs. 1—4. (To this species O. F. MUELLER refers *Helix haliotoïdea*, which we noted above at *Sigaretus*.)

*Natica* LAM. (*Neritæ umbilicatæ* L.). Shell subglobose, umbilicate, with spire short and last wreath tumid, large. Aperture semiorbicular, with lip oblique, edentulous, callous. Head of animal with broad velum; tentacles two; eyes small, sessile at the base of tentacles. Foot very ample.

Sp. *Natica mammilla* LAM., *Nerita mammilla* L., RUMPH. *Amb. Rariteitk.* Tab. 22, fig. F, BLAINV. *Malacol.* Pl. 36 bis, fig. 5, &c. Species numerous.

*Note.*—Genus *Deshayesia* RAULIN (GUÉRIN *Magas.* 1844, *Moll.* 111), fossil, intermediate between *Nerita* and *Natica*, still appears to be more nearly related to the *Naticæ*.

*Janthina* LAM. Shell ventricose, thin, pellucid. Aperture triangular. Columella straight, produced beyond the margin of aperture. Animal with proboscis large, cylindrical, and two tentacles deeply cloven. A vesicular or spumose organ adhering to foot. Operculum none.

Comp. on this genus, CUVIER *Ann. du Mus.* XI. pp. 121—130, *Moll.*, *Mém.* 15, pp. 2—10, figs. 1—8.

Sp. *Janthina communis*, *Helix Janthina* L., RUMPH. *Amb. Rariteitk.* Tab. XX. fig. 2, BLAINV. *Malacol.* Pl. 37 bis, fig. 1; in the Mediter. Sea and in the Atl. Ocean, in warm climates. The foamy organ at the foot serves for attaching the covering of the eggs, and, according to RANG, is afterwards cast off. Is this organ peculiar to the females?

*Scalaria* LAM. Shell turrite, with ribs longitudinal, compressed, interrupted. Aperture rotundate, with margins connected, marginate, reflected. Animal with long retractile proboscis; eyes sessile at the base of tentacles. Operculum horny.

Sp. *Scalaria pretiosa* LAM., *Turbo scalaris* L., RUMPH. *Amb. Rariteitk.* Tab. 49, fig. A, GUÉRIN *Iconogr., Moll.* Pl. 12, fig. 11; the *true winding stair*, from the Indian Ocean;—*Scal. communis* LAM., *Turbo clathrus* L., BLAINV. *Malac.* Pl. 34, fig. 2; in the Atl. Ocean, the North Sea, the Mediter. There are various fossil species from the tertiary formations. Comp. LAMARCK *Ann. du Mus.* V. pp. 212—214, VIII. Pl. 37, figs. 3—5.

*Pyramidella* LAM. Shell turrite. Aperture entire, semioval, with labrum acute. Columella with three transverse folds. Operculum horny. Tentacles broad, long, sulcate; eyes sessile at the base of tentacles.

Sp. *Pyramid. dolabrata* LAM., *Trochus dolabratus* L., BLAINV. *Malac.* Pl. 21, fig. 4, CUV. *R. Ani., éd. ill., Moll.* Pl. 45, fig. 3;—*Pyr. ventricosa* GUÉRIN, *Magas. de Zool.* 1831, *Moll.* Pl. 2, &c. (Species marine, exotic.)

*Tornatella* LAM. (in part). Shell convolute, ovato-cylindrical, frequently transversely striated. Aperture entire, oblong, with external margin acute. Columella plicate. Operculum horny.

Sp. *Tornatella fasciata* LAM., *Voluta tornatilis* L., *Encycl. méth., Vers.* Pl. 452, fig. 3, BLAINV. *Malac.* Pl. 38, fig. 5, &c.

*Trochus* L. Shell turbinate, with aperture sinuoso-quadrangular, depressed, obliquely truncated. Animal with mantle often appendiculate on both sides.

*Solarium* LAM. Shell orbicular, conico-depressed, umbilicate, with umbilicus patulous, crenulate or dentate at the internal margins of wreaths. Columella none. Operculum horny.

Sp. *Trochus perspectivus* L., *Solarium perspectivum* LAM., LISTER *Conch.* Tab. 636, fig. 24, RUMPH. *Amb. Rariteitk.* Tab. 27, fig. L, &c.

*Euomphalus* SOW. (fossil genus).

*Bifrontia* DESH., *Schizostoma* BRONN.

*Rotella* LAM. Shell orbicular, shining, imperforate. Spire very short, subconical. Columella callous, convex.

Sp. *Trochus vestiarius* L., *Rotella lineolata*, &c.

*Trochus* LAM. Shell conical, in some umbilicate, in others imperforate. Aperture transversely depressed, with margins disjoined above. Columella arcuate, somewhat prominent at the base. Operculum mostly horny, more seldom calcareous.

*Tops.* Comp. on the animal of this genus CUVIER *Ann. du Mus.* XI. pp. 184, 185, *Moll., Mém.* 16, pp. 15, 16, fig. 13.

Sp. *Trochus solaris* L., CHEMN. *Conchyl.* Tab. 173, figs. 1700, 1701, REEVE *Conch. Syst.* II. Pl. 214, figs. 1, 2;—*Troch. niloticus* L., RUMPH. *Amb. Rariteitk.* Tab. 21, fig. A, *Encycl. méth., Vers.* Pl. 444, fig. 1, &c. *Trochus Cookii* CHEMN., LAM., LESSON, *Ill. de Zool.* Pl. 15, from which LESSON forms the genus *Cookia*, belongs, according to DESHAYES, to *Turbo*.

*Trochus conchyliophorus* BORN., GM., CUV. *R. Ani., éd. ill., Moll.* Pl. 41, fig. 3. This species causes little stones and pieces of bivalves from the bottom on which it creeps to adhere to its shell; these foreign bodies in time grow to the shell which thus acquires a very irregular appearance. LAMARCK confounded with this species, from the West Indian Seas, a fossil species from the tertiary formations, which presents the same peculiarity, under the name of *Trochus agglutinans*. Comp. on the fossil species LAMARCK *Ann. du Mus.* IV. pp. 46—51, VII. Pl. XV. figs. 5—7.

*Monodonta* LAM., *Labio* OKEN.

*Delphinula* LAM. Shell umbilicate, subdiscoidal or conical, with wreaths rough or angulate. Aperture entire, rotund, sometimes trigonal, with convex margins. Operculum horny or calcareous.

Sp. *Delphinula laciniata, Turbo Delphinus* L., RUMPH. *Amb. Rariteitk.* Tab. 20, fig. H, BLAINVILLE *Malacol.* Pl. 33, fig. 3, &c. This genus is scarcely distinguishable from the preceding, but has a circular aperture separate from the columella.

*Turbo* L. (in part), LAM. Shell conoid or subturrite, with wreaths rotundate. Aperture entire, rotund, not deformed by the penultimate

turn, with margins disjoined above. Columella arcuate, flattened, not truncated at the base. Animal with slender acuminate tentacles and pedunculate eyes at the outside of tentacles. Operculum mostly thick, calcareous.

The species of this genus are very numerous. Those which shine nacreous and silvery within, with a mostly very thick operculum, are more especially named *Turbo*, as *Turbo chrysostomus* L., RUMPH. *Amb. Rariteit.* Tab. 19, fig. E, *Turbo argyrostomus* L., CHEMN. *Conchyl.* Tab. 177, figs. 1758, 1759, CUV. *R. Ani., éd. ill., Moll.* Pl. 42, fig. 1, &c.

The species which have no nacreous splendour internally, and which have constantly a horny operculum, are united under the following subgenus.

*Littorina* FÉRUSS.

Sp. *Turbo littoreus* L., *Alikruik, Vigneau, Guignette;* SWAMMERD. *Bibl. nat.* I. pp. 180—185, Tab. IX. fig. 14, BASTER *Natuur. Uitsp.* I. pp. 127, 128, Tab. 14, fig. 1; this little snail, boiled with salt, is eaten in Zealand.

*Phasianella* LAM. Shell ovate or conical, solid, imperforate. Columella smooth, rotundate. Aperture ovate, longitudinal. Animal with two laciniate labia. Two long conical tentacles; eyes seated in tubercles at the base of tentacles. Body margined by a laciniate membrane.

Comp. CUVIER *Ann. du Mus.* XI. pp. 130—135, *Mém. s. l. Moll.* No. 15, pp. 10—15, figs. 9—13.

Sp. *Phasianella bulimoïdes* LAM., *Buccinum australe* GMEL., BLAINV. *Malacol.* Pl. 37, fig. 5, from the S. Pacific, at New Zealand and New Holland. Some species of this genus of LAMARCK are referred by DESHAYES to genus *Littorina*. There are some fossil species of *Phasianella* from the tertiary formations; LAMARCK *Ann. du Mus.* IV. pp. 295—297, VIII. Pl. 60, fig. 1.

*Turritella* LAM. Shell elongato-conical, acuminate, turbinate. Aperture circular, entire, with margins disjoined above, labrum emarginate by a sinus.

Sp. *Turritella bicingulata* LAM., BLAINV. *Malacol.* Pl. 21, fig. 3; *Turritella duplicata* LAM., *Turbo duplicatus* L., REEVE *Conch. Syst.* II. Pl. 224, fig. 1, &c. To this genus belong numerous fossil species.

*Paludina* LAM. Shell turbinate, with rotundate wreaths. Aperture subrotund, somewhat oblong, angulate above, with margins connected, acute. Operculum horny, orbicular. Animal with tentacles acuminate, eyes sessile at the base of tentacles, mantle alate, appendiculate.

Sp. *Paludina vivipara* LAM., *Helix vivipara* L., SWAMMERDAM *Bibl. nat.* I. pp. 169—180, Tab. IX. figs. 15—18; CUV. *Ann. du Mus.* XI. p. 170, *Moll.*

*Mém.* 15; PFEIFFER *Land- u. Wasserschn.* I. Tab. IV. figs. 42, 43; STURM *Deutschl. Faun.* VI. 2; BLAINV. *Malacol.* Pl. 36, fig. 4; the shell is a dull-green, with red-brown bands and very convex wreaths. The right tentacle is perforated in the male individuals with an aperture which gives passage to the penis. The gills consist of three series of filaments. This snail, common in fresh water, is viviparous, and the females are full of young in spring. It is found in Holland in canals and other fresh water, in the mud or hiding under stones, also creeping under water-plants, &c. [Consult especially, in addition to the works cited above, LEYDIG *Ueber Paludina vivipara, ein Beitrag zur nähern Kenntniss dieses Thieres in embryologischer, anatomischer und histologischer Beziehung*, in SIEBOLD u. KOELLIKER'S *Zeitsch. f. wissench. Zool.* II. 1850, pp. 125—197, Pl. XI. XII. XIII.]

*Valvata* MUELL. Shell discoidal or conical, with cylindrical wreaths. Aperture rotundate. Animal furnished with horny orbicular operculum, with foot anteriorly truncate or emarginate, with two slender tentacles, and with eyes sessile at the base of tentacles.

Sp. *Valvata piscinalis* FÉRUSS., LAM., *Cyclostoma obtusum* DRAP., PFEIFFER *Land- u. Wasserschn.* I. Tab. IV. fig. 32, STURM *Deutschl. Fauna*, VI. Heft 4, Tab. 2, BLAINV. *Malacol.* Pl. 34, fig. 4, in fresh water, canals, &c.

*Cyclostoma* LAM., DRAPARN. Shell conical, short, with cylindrical wreaths, the last ample, tumid. Aperture regular, rotund, with margins connected orbiculately, reflected by age. Animal with a thin orbicular operculum, two tentacles, and petiolate eyes at the base of tentacles.

Sp. *Cyclostoma elegans* DRAPARN., *Nerita elegans* MUELL., BLAINV. *Malacol.* Pl. 34, fig. 7, PFEIFFER *Land- u. Wasserschn.* I. Tab. IV. figs. 30, 31, GUÉRIN *Iconogr., Moll.* Pl. 12, fig. 12, &c. This genus also counts many fossil species from the tertiary formations.

These animals differ from the rest of this family, inasmuch as they do not live in water, but in moist places, and breathe atmospheric air. Also they have a vascular net in place of gills, and on this account might belong to the following family, if the whole form of the body and the internal structure did not remove them from the *Pneumonica* and place them in the neighbourhood of *Turbo*.

*Helicina* LAM.

*Ampullaria* LAM. Shell globose, ventricose, umbilicate, with spire short, obtuse, sometimes discoidal. Aperture entire, oblong. Animal furnished with operculum, with long tentacles, and petiolate eyes at the base of tentacles. Respiratory cavity large, containing a pectinate branchia composed of a row of lamellæ, and a vascular pulmonary cavity.

Sp. *Ampullaria fasciata* LAM., *Helix ampullacea* L., RUMPH. *Amb. Rariteitk.* Tab. 27, fig. Q, *Encycl. méth., Vers.* Pl. 457, figs. 3, A, B, &c. Fresh-water molluscs of tropical countries, much allied to *Paludina* and *Cyclostoma* See F. H. TROSCHEL *Anatomie von Ampullaria urceus und ueber die Gattung Lanistes* MONTF. in ERICHSON'S *Archiv f. Naturgesch.* 1845, s. 197—216, Taf. 8. To *Ampullaria* belongs also *Planorbis Cornu Arietis* LAM.

*Planaxis* LAM.

Sp. *Planaxis sulcata* LAM., BLAINV. *Malacol.* Pl. 16, fig. 14.

*Rissoa* FREMINV. Shell mostly turrite, sometimes globose, with oval aperture, labrum incrassate, exsert anteriorly and subarcuate near the columella, the apex acuminate. Operculum horny. Tentacles elongate. Eyes placed at the base of tentacles. Foot oblong, anteriorly truncated, posteriorly acuminate.

This genus consists of small marine animals, whose little shell has some resemblance to *Turbo* or *Scalaria*, and of which the numerous species have become known in the last few years alone; there are also many fossil species, almost all from the tertiary formations. Compare DESHAYES in LAMARCK *Hist. nat. des Ani. s. vert.* 2e éd. VIII. pp. 461—485; J. ALDER *Ann. of Nat. Hist.* XIII. pp. 323—328; LOVÉN *Ind. Molluscor. öfversigt*, 1846, pp. 24—26.

*Melania* Lam. Shell turrite, with apex often decorticated, eroded. Aperture entire, ovate or oblong, effuse at the base. Columella smooth. Operculum horny, elongate. Animal elongate, with foot small, and two elongate filiform tentacles.

*Note.*—Genus *Pirena* LAM., *Pyrena* MENKE, GRAY is, according to DESHAYES, to be abolished. Smooth and shining marine species of *Melania* form the sub-genus *Eulima* RISSO. The rest of the species, all fluviatile, form the sub-genera *Melania*, and *Melanopsis* FÉRUSS., LAM.

Sp. *Melania amarula* LAM., *Helix amarula* L., RUMPH. *Amb. Rariteitk.* Tab. 33, fig. F, F; BLAINV. *Malacol.* Pl. 35, fig. 7;—*Melania Rangii* DESH., *Melan. tuberculosa* RANG, GUÉRIN *Mag. de Zool.* 1832, *Moll.* Pl. 13 (a fig. with the animal) &c. The species are especially numerous in the rivers and fresh waters of the Sunda Islands; comp. MOUSSON *Molluscken von Java*, 1849, s. 65—79. An European species, *Melan. helvetica* MICHELIN, GUÉR. *Mag. de Zool.* 1831, *Moll.* Pl. 37, forms the *typus* of the gen. *Pyrgula* DE CHRISTOF. and JAN.; DESHAYES thinks this species ought not to be separated from *Melania;* others refer it to *Paludina.*

(*Melanopsis.* Columella truncated, disjoined from labrum by a sinus.)

Sp. *Melania buccinoïdea* OLIV., *Buccinum prœrosum* L., OLIV., *Voyage*, Pl. 17, fig. 8, REEVE *Conchyl. Syst.* II. Tab. 195, fig. 2, &c. Comp. on the species of this sub-genus FÉRUSSAC *Monogr. des espèces vivantes et fossiles du genre Mélanopside, Mém. de la Soc. d'Hist. nat. de Paris*, I. 1823, pp. 132—164, Pl. 7, 8.

Phalanx III. *Cerycoïdea* (*Buccinoïdea* CUV.). Cochlea spiral, with aperture emarginate or canaliculate towards the columella, a canal receiving the tube of mantle.

*Cerithium* ADANS., BRUG., LAM. Shell turrite. Aperture oval, oblique, terminated by a short canal truncated or recurved. Animal with two tentacles acuminate, furnished with an oculiferous tubercle towards the base.

Sp. *Cerithium palustre* LAM., *Strombus palustris* L., RUMPH. *Amb. Rariteitk.* Tab. 30, fig. Q; BLAINV. *Malacol.* Pl. 20, fig. 4;—*Cerith. telescopium*, *Trochus telescopium* L., RUMPH. *Amb. Rariteitk.* Tab. 21, fig. 12, D'ARGENV. *Conchyl.* Tab. 11, fig. 2, BLAINV. *Malac.* Pl. 32 bis, fig. 2, &c. A very numerous genus of which the species live in great part in the sea, partly in brackish water or at the mouths of rivers. The fossil species which are still more numerous (more than 300 according to DESHAYES), are almost all limited to the tertiary formations. Amongst these *Cerithium giganteum* deserves to be noticed, a species found in France near *Grignon*.

The sub-genus *Potamides* (*Ann. du Mus.* XV. pp. 367—370) is usually not accepted by later writers.

*Fastigiella* REEVE.

Sp. *Fastig. carinata* REEVE, *Ann. of Nat. Hist.*, second series, II. 1848, p. 66. (*Habitus* of *Turritella*, characters almost of *Cerithium*.)

*Pleurotoma* LAM. Aperture produced into an elongated straight canal. Shell turrite or fusiform. Columella smooth. Lip cloven or emarginate by a sinus. Two conical tentacles; eyes at the base of tentacles externally. Operculum horny.

Sp. *Pleurotoma babylonia* LAM., *Murex babylonius* L., RUMPH. *Amb. Rariteitk.* Tab. 29, fig. L, BLAINV. *Malacol.* Pl. 15, fig. 3, CUV. *R. Ani., éd. ill., Moll.* Pl. 60, fig. 2, &c. A numerous genus, of which also several fossil species are known.

*Fusus* BRUG. (in part), LAM. Shell destitute of spines; aperture produced into a long straight canal. Columella smooth. Labrum entire. Operculum horny.

*Fusus* LAM. Shell fusiform, spire elongate, ventricose in the middle.

Sp. *Fusus syracusanus* Lam., *Murex syracusanus* L., Poli *Testac. utr. Sic.* III. Tab. 48, figs. 11, 12, Blainv. *Malacol.* Pl. 15, fig. 1;—*Fusus colosseus* Lam., *Encycl. méth., Vers.* Pl. 427, fig. 1, &c.

*Pyrula* Lam. (excl. some species). Shell subpyriform, with short spire.

Sp. *Pyrula melongena, Murex Melongena* L., Rumph. *Amb. Rariteitk.* Tab. XXIV. fig. 2, Blainv. *Malac.* Pl. 17, fig. 3;—*Pyr. perversa, Murex perversus* L., *Encycl. Vers.* Pl. 433, fig. 4, Reeve *Conch. Syst.* II. Pl. 236, figs. 5, &c.

*Murex* L. (in part), Brug. Shell spiral with transverse tubercles or spines in rows. Aperture rotundate, produced into a straight canal; columella smooth. Operculum horny.

*Murex* Lam. Shell with horny tubercles or spines disposed in several longitudinal rows. Canal of aperture often very long.

Sp. *Murex Brandaris* L., Poli *Testac. utr. Sicil.* III. Tab. 49, fig. 8, Guérin *Iconogr., Moll.* Pl. 19, fig. 1, Leiblein, Heusinger's *Zeitschr. f. die organ. Physik.* Eisenach, 1827, I. Heft 1, pp. 1—32, Tab. I. *Ann. des Sc. nat.* XIV. pp. 176—206, Pl. 10, 11; Mediter. Sea;—*Murex Tribulus* L., *Murex crassispina* Lam., Blainv. *Malac.* Pl. 17, fig. 2;—*Murex tenuispina* Lam. (*Mur. Tribulus var.* L.), Rumph. *Amb. Rariteitk.* Tab. 26, fig. 3, Kiener *Spec. général des Coq. viv., canalifères,* III. Pl. 6, fig. 1, Pl. 7, fig. 1;—*Murex Haustellum* L., Blainv. *Malacol.* Pl. 19, fig. 5, Guérin *Iconogr., Moll.* Pl. 19, fig. 2, &c. Of this genus also there are various fossil species.

*Ranella* Lam. Shell ovate or oblong, with ribs compressed, varicose, opposite, remote at the middle part of the wreath.

*Murex Rana* L. (in part), *Ranella crumena* Lam., Rumph. *Amb. Rariteitk.* Tab. 24, fig. G, *Encycl. méth., Vers.* Pl. 412, fig. 3, &c.

*Triton* Montf., Lam. Shell ovate or oblong, with varices rare, not forming longitudinal series.

Sp. *Murex Tritonis* L., *Triton variegatum* Lam., Rumph. *Amb. Rariteitk.* Tab. 28, fig. B and 1, *Encycl. méth., Vers.* Pl. 421, fig. 2, Blainv. *Malacol.* Pl. 18, fig. 3; from the Indian Ocean;—*Triton nodiferum* Lam., Poli *Test. utr. Sic.* III. Pl. 49, fig. 9; from the Medit. Sea. To this last species belongs the anatomical description of K. W. Eysenhardt, Meckel's *Archiv f. d. Physiol.* VIII. 1823, pp. 213—217, Tab. III.

*Fasciolaria* Lam. Aperture ending in a straight canal. Shell oblong, scarcely tuberculate. Columella furnished with two or three oblique folds.

Sp. *Fasciolaria tulipa* Lam., *Murex Tulipa* L., Rumph. *Amb. Rariteitk.* Tab. 49, fig. H, Blainv. *Malac.* Pl. 17, fig. 2.

*Turbinella* LAM. (species of *Voluta* L.). Shell turbinate or subfusiform, with aperture terminating in a canal. Columella with three or more transverse compressed folds.

Sp. *Turbinella pyrum* LAM., *Voluta Pyrum* L., RUMPH. *Amb. Rariteitk.* Tab. 36, fig. 7, GUÉRIN *Iconogr., Moll.* Pl. 20, fig. 9;—*Turbin. craticulata* LAM., *Murex craticulatus* L., *Encycl. méth., Vers.* Pl. 429, fig. 3. With the exception of this species, LINNÆUS in the last edition of the *Syst. nat.* brings the species of this genus known to him to *Voluta*. The species are numerous and resemble in form either *Fusus* or *Pirula*, from which they differ by the transversely striped columella alone.

*Cancellaria* LAM. Shell oval or turrite, mostly reticulate with transverse stripes and longitudinal rugæ. Aperture ending in a short canal. Columella with transverse folds; labrum furrowed internally.

Sp. *Cancellaria reticulata* LAM., *Voluta reticulata* L., D'ARGENV. *Conch.* Pl. 17, fig. M, *Encycl. méth., Vers.* Pl. 375, fig. 3, BLAINV. *Malacol.* Pl. 22, fig. 1, &c. CUVIER regarded this genus as a sub-division of *Voluta;* DESHAYES is inclined to place it in the neighbourhood of *Tornatella*. There is no operculum present. Many fossil species from the tertiary formations are known.

*Struthiolaria* LAM.

Sp. *Struthiolaria nodulosa* LAM., *Murex pes struthiocameli* CHEMN., SPENGLER *Naturforscher,* XVII. Tab. II. figs. A, B, BLAINV. *Malacol.* Pl. 17, fig. 10, &c.

*Rostellaria* LAM. (in part), *Chenopus* PHILIPPI, *Aporrhais* PETIVER, GRAY.

Sp. *Strombus Pes pelecani* L., POLI *Test. utr. Sicil.* III. Pl. 48, figs. 7—10, BLAINV. *Malac.* Pl. 21, fig. 6, &c.

*Strombus* L. Shell turrite, with labrum dilated into a very ample wing excised towards the canal by a sinus. Canal straight or inflected by the columella obliquely outwards. Operculum horny. Tentacles bifid, the internal lacinia conical, the external peduncle cylindrical, oculiferous at the apex.

* *Canal subulate; sinus of labrum contiguous to the canal.* Spec. of *Rostellaria* LAM.

Sp. *Strombus Fusus* L., *Rostellaria rectirostris* LAM., D'ARGENV. *Conch.* Pl. 10, fig. D, REEVE *Conch. Syst.* II. Tab. 246, fig. 4;—*Rostell. curvirostra* LAM., *Encycl. méth., Vers.* Pl. 411, fig. 1, BLAINV. *Malacol.* Pl. 16, fig. 1.

** *Canal elongate; sinus of labrum not contiguous to canal. Labrum produced into digitate laciniæ. Pterocera* LAM.

Sp. *Strombus Chiragra* L., LISTER *Conch.* Pl. 870, fig. 24;—*Strombus Scorpius* L., D'ARGENV. *Conch.* Pl. 14, fig. B, BLAINV. *Malac.* Pl. 25, figs. 3, 4, GUÉRIN *Iconogr., Moll.* Pl. 21, fig. 2, &c.

*** *Canal short, emarginate or truncated. Sinus of labrum distinct from canal. Labrum in more adult shells expanded into a wing simple, entire. Strombus* LAM.

Sp. *Strombus gigas* L., LISTER *Conchyl.* Tab. 863, fig. 18;—*Strombus latissimus* L., LISTER Tab. 862, fig. 18 (856, fig. 12 young);—*Strombus lentiginosus* L., CUV. *R. Ani., éd. ill., Moll.* Pl. 61, fig. 2, &c.

*Cassis* LAM., *Cassidea* BRUG. (spec. of *Buccinum* L.). Shell ventricose or inflated, with spire short. Aperture longitudinal, terminating in a short canal. Columella transversely plicate or rugose.

a) *Canal incurved obliquely to the left and upwards or substraight. Cassidaria* LAM.

Sp. *Cassis echinophora, Buccinum echinophorum* L., RUMPH. *Amb. Rariteitk.* Tab. 27, fig. 1, GUÉRIN *Iconogr., Moll.* Pl. 16, fig. 6, &c.—The genus *Oniscia* SOWERBY is distinguished by a short canal and a lamina, covered with granular inequalities, extending from the columella over the last wreath: *Cassidaria Oniscus* LAM., *Strombus Oniscus* L., &c. See REEVE *Conch. Syst.* II. pp. 210—212, Pl. 253, 254.

b) *Canal ascending, excised deeply towards the extremity. Cassis* LAM.

Sp. *Cassis cornuta* LAM., *Buccinum cornutum* L., LISTER *Conchyl.* Tab. 1008;—*Cassis tuberosa* LAM., *Buccinum tuberosum* L., *Encycl. méth., Vers.* Pl. 406, fig. 1, Pl. 407, fig. 2, BLAINV. *Malacol.* Pl. 23, fig. 1;—*Cassis glauca* LAM., *Buccinum glaucum* L., RUMPH. *Amb. Rariteitk.* Tab. 25, figs. A and 4, CUV. *R. Ani., éd. ill., Moll.* Pl. 56, fig. 1, &c.

Fossil species also of this genus are found.

*Purpura* BRUG. Shell oval, often tuberculate, with spire short, last wreath ample. Aperture terminating in a sinus oblique, subcanaliculate. Columella smooth, acuminate towards the apex. Operculum thin, horny.

DUCLOS (*Ann. des Sc. nat.* XXV. 1832, pp. 90—95, XXVI. pp. 103—112), DESHAYES (*Encycl. méth., Vers.* III. pp. 838—845) and BLAINVILLE (*Nouv. Ann. du Mus.* I. pp. 189—263) have united under the name of *Purpura*, besides *Monoceros* and *Ricinula* of LAMARCK, also *Concholepas* LAM.; they regard these genera merely as divisions of a great genus, to which more than 200 species now belong.

*Ricinula* LAM. Aperture oblong, narrowed by unequal teeth at the columella and the internal surface of labrum. Shell often tuberculato-spinose.

Sp. *Purpura ricinus, Murex Ricinus* L.; *Ricinula arachnoïdes* LAM., *Enc. méth., Vers.* Pl. 395, fig. 3;—*Ricinula horrida* LAM., BLAINV. *Malac.* Pl. 22, fig. 2, &c.

*Purpura* LAM. Aperture dilated, with columella short.

Sp. *Purpura persica* LAM., *Buccinum persicum* L., RUMPH. *Amb. Rariteith.* Tab. 27, fig. E, BLAINV. *Malacol.* Pl. 24, fig. 3. (Most of the species belong to this division, of which fossil species also occur.)

(*Monoceros* LAM. differs from the *Purpuræ* by a conical tooth at the internal margin of labrum. Sp. *Purpura monodon, Monoceros imbricatum* LAM., *Buccinum monodon* GMEL., BLAINV. *Malac.* Pl. 22, fig. 3, &c.

*Concholepas* LAM. Vertex not spired, inclined obliquely towards labium. Aperture longitudinal, oblique, very ample.

Sp. *Purpura concholepas* nob., *Concholepas peruvianus* D'ARGENV. *Conch.* Pl. 2, fig. D, BLAINV. *Malacol.* Pl. 24, fig. 1, LESSON *Illustr. de Zool.* Pl. 27 (a figure with the animal). This singular shell, which at first sight might be taken for a single conch of a bivalve, was received by GMELIN into the thirteenth edition of the *Syst. nat.* under the name of *Patella lepas.*

*Harpa* LAM. Shell ovate, turgid, with longitudinal parallel ribs. Aperture oval, terminating at the apex in an excised sinus. Columella lævigato-gibbous, oblique. Spire short. Animal with foot large, semicircular anteriorly, and operculum none. Tentacles conical, incrassate at the base, oculiferous on the outside.

Sp. *Harpa imperialis* LAM., *Buccinum costatum* L., D'ARGENV. *Conchyl., Append.* Pl. 2, fig. F, CHEMN. Tab. 152, fig. 1452;—*Harpa ventricosa* LAM., *Buccinum Harpa* L. (in part), *Encycl. méth., Vers.* Pl. 404, fig. 1, GUÉRIN *Iconogr., Moll.* Pl. 18, fig. 1. Comp. REYNAUD *Observations sur l'Animal de la Harpe, Mém. de la Soc. d'Hist. nat. de Paris,* v. 1834, pp. 33—40, Pl. 3.

*Dolium* LAM. Shell thin, ventricose, smooth, surrounded by transverse ribs. Aperture longitudinal, terminated anteriorly by a sinus. Columella oblique. Labrum transversely crenate. Spire short. Foot large, without operculum.

Sp. *Dolium perdix* LAM., *Buccinum Perdix* L., D'ARGENV. *Conchyl.* Tab. 17, fig. A, MARTINI Tab. 117, fig. 1079, GUÉRIN *Iconogr., Moll.* Pl. 17, fig. 10, CUV. *R. Ani., éd. ill., Moll.* Pl. 54, fig. 2;—*Dolium galea* LAM., *Buccinum galea* L., MARTINI Tab. 116, fig. 1070, POLI *Test. utr. Sic.* III. Pl. 47, figs. 3, 4; a gigantic species from the Mediterranean Sea.

*Buccinum* L. (excl. many spec.), LAM. (add genus *Nassa* LAM.). Shell ovate or ovato-conical, gibbous. Aperture longitudinal, emarginate by a sinus towards the apex. Operculum horny.

Sub-genera: *Nassa, Buccinum, Tritonium* MUELL. and DESHAYES (species of *Buccinum* LAM.). Comp. DESHAYES in LAMARCK *Hist. nat. des Ani. s. vert.* x. pp. 151, 152.

Sp. *Buccinum undatum* L., *Encycl. méth., Vers.* Pl. 399, fig. 1, BLAINV. *Malac.* Pl. 22, fig. 4. (See an anatomical description of this species by CUVIER, *Ann. du Mus.* XI. pp. 447—457, *Mém. s. l. Mollusq.* No. 17.)

To *Buccinum* belongs also the genus *Eburna* LAM. (with the exclusion of *Eburna glabrata, Ancillaria glabrata* SOWERBY). Sp. *Buccinum spiratum* L., RUMPH. *Amb. Rariteitk.* Tab. 49, fig. D, *Encycl. méth., Vers.* Pl. 401, fig. 4.

*Terebra* BRUG. (species from genus *Terebra* ADANS.), *Subula* SCHUMACHER, BLAINV. Shell turrite, subulate. Aperture longitudinal, much shorter than spire, excised at the apex by a sinus. Columella oblique, plicate; labrum with margin acute, thin. Operculum horny.

Sp. *Terebra maculata* LAM., *Buccinum maculatum* L., D'ARGENVILLE *Conchyl.* Pl. 11, fig. A, *Encycl. méth., Vers.* Pl. 402, fig. 1.

*Conus* L. Shell convolute, conical. Spire short, sometimes acuminate, mostly flattened. Aperture narrow, longitudinal, edentulous. Columella short. Animal with foot anteriorly truncated, posteriorly attenuate, rotundate, with horny operculum; head with two tentacles subulate, bearing eyes on the outside towards the apex.

Sp. *Conus imperialis* L., RUMPH. *Amb. Rariteitk.* Tab. 34, fig. H, *Encyclop. méth., Vers.* Pl. 319, figs. 1, 2, BLAINV. *Malac.* Pl. 26, fig. 5;—*Conus gloria maris* CHEMN., *Conch.* Tab. 143, figs. 1324, 1325, *Enc. méth., Vers.* Pl. 347, fig. 7. A very numerous genus of more than 300 species (according to DESHAYES, LAMARCK *Hist. nat. d. Ani. s. v., sec. éd.* XI. p. 7). Beautiful figures of many species are found in the *Encycl. méth., Vers.* Pl. 315—347. Almost all are from the tropical seas; many fossil species from the tertiary formations are known.

*Voluta* L. (exclusive of many species), LAM. Shell ovate, very often ventricose, with apex obtuse. Aperture longitudinal, excised towards the end by a sinus. Columella obliquely plicate. Animal without operculum.

Sp. *Voluta æthiopica* LAM. (*Voluta æthiopica* L. in part), *Encycl. méth., Vers.* Pl. 387, fig. 1, CUV. *R. Ani., éd. ill., Moll.* Pl. 52, fig. 1, &c.

*Volvaria* LAM. (in part), SOWERBY.

Species fossil. Comp. REEVE *Conchol. Syst.* II. pp. 246—248.

*Mitra* LAM. Shell mostly fusiform, with apex acute. Folds of columella suboblique, transverse, decreasing forwards. Aperture narrow, broader anteriorly, terminated by a deep oblique sinus ascending upwards. Animal with tentacles oculiferous externally at the sides or at base; exsert proboscis surpassing the shell in length.

a) *With spire elongate.*

Sp. *Mitra episcopalis* LAM., *Voluta mitra* L. (in part), RUMPH. *Amb. Rariteitk.* Tab. 29, fig. K, D'ARGENVILLE *Conchyl.* Pl. 9, fig. C, BLAINV. *Malacol.* Pl. 28 bis, fig. 1, KIENER *Coq. viv., Columellaires, Mitre,* Pl. 1. fig. 1 (fig. with the animal);—*Mitra vulpecula* LAM., *Voluta Vulpecula* L., GUÉRIN *Iconogr., Moll.* Pl. 17, fig. 1.

b) *With spire shorter.* (*Habitus* nearly of *Conus.*) *Conohelix* SWAINS., SOWERBY, *Imbricaria* SCHUMACHER.

Sp. *Mitra dactylus* LAM., *Voluta Dactylus* L., BLAINV. *Malacol.* Pl. 28 bis, fig. 3, GUÉRIN *Iconogr., Moll.* Pl. 17, fig. 2.

*Marginella* LAM. (with addit. of several spec. of *Volvaria* ejusd.). Shell ovato-oblong, smooth, with short spire. Aperture scarcely sinuate. Columella with folds transverse, oblique, subequal. Labrum incrassated externally.

Sp. *Marginella faba, Voluta Faba* L., *Encycl. méth., Vers.* Pl. 377, fig. 1, BLAINV. *Malac.* Pl. 30, fig. 5, &c.

*Terebellum* LAM. Shell convolute, subcylindrical, with apex acute. Aperture longitudinal, narrow, broader towards the end, terminated by sinus. Columellar margin produced with apex truncated beyond labrum. (Animal with tentacles filiform, oculiferous at the point.)

Sp. *Terebellum subulatum, Bulla terebellum* L., RUMPH. *Amb. Rariteitk.* Tab. 30, fig. S, BLAINV. *Malac.* Pl. 27, fig. 1, ADAMS and L. REEVE *Mollusca of the Voyage of H.M.S. Samarang,* 1848, Pl. IX. fig. 6 (a fig. of the animal with the shell) in the Ind. Ocean. *Terebellum convolutum* BLAINV. l. l. fig. 2 a fossil species from the *calcaire grossier.*

*Columbella* LAM. Shell oval, spire short. Aperture emarginate towards the end. Labrum gibbous internally, often denticulate, narrowing the aperture.

*Columbella rustica* LAM., *Voluta rustica* L., POLI *Test. utr. Sic.* III. Pl. 46, figs. 39—41;—*Columbella strombiformis* L., BLAINV. *Malac.* Pl. 30, fig. 5, &c.

*Ancillaria* LAM. Shell oblong, smooth. Aperture longitudinal, sinuate towards the end. Columella tumid, contorted. Spire short, with sutures of wreaths not canaliculate.

Sp. *Ancillaria cinnamonea* LAM. (*Bulla cyprœa* L. ?), &c. (A genus scarcely distinct from *Oliva*, of which perhaps it is to be regarded as a sub-generic section.)

*Oliva* BRUG., LAM. Shell smooth, subcylindrial, convolute, polished, with spire short and sutures canaliculate. Aperture longitudinal, terminating in a sinus. Columella obliquely striated. Labrum somewhat thick, with margin inflected towards the aperture. Animal with foot elongate, furnished anteriorly with a triangular lobe, without operculum; tentacles incrassated at the base, oculiferous on the outside, attenuated at the apex.

Sp. *Oliva porphyria* LAM., *Voluta porphyria* L., D'ARGENVILLE *Conch.* Pl. 13, fig. K, *Encycl. méth., Vers.* Pl. 361, fig. 4, REEVE *Conch. Syst.* II. Pl. 273, fig. 1;—*Oliva maura* LAM., *Voluta Oliva* L. (in part), RUMPH. *Amb. Rariteik.* Tab. 39, fig. 2, CUV. *R. Anim., éd. ill., Moll.* Pl. 51, fig. 3, &c. The species are numerous, many much resembling each other, and on account of the manifold varieties which some present, difficult to distinguish. There are also some fossil species known, which occur in the tertiary formations.

*Ovula* BRUG. Shell involute, turgid, polished; spire concealed. Aperture longitudinal, narrow, produced at both ends beyond the columella, with columellar margin edentulous. Labrum often incrassated, inflected, flat, transversely crenate.

Sp. *Ovula oviformis* LAM., *Bulla Ovum* L., RUMPH. *Amb. Rariteik.* Tab. 38, fig. Q, BLAINV. *Malac.* Pl. 31, fig. 1; white, the outer margin of the mouth toothed, just as in *Cyprœa*, from which genus this species is in fact distinguished merely by the smooth, convex inner margin. The animals, moreover, of the two genera are very similar. In other species the external margin is smooth; such is the case in *Ovula volva* LAM., *Bulla Volva* L., BLAINV., l. l. fig. 3, where it terminates at both sides in a long tube.

*Cyprœa* L. Shell involute, polished, convex above, flattened at the aperture. Aperture straightened, longitudinal, effuse at both ends. Either labium transversely crenate. Spire very small, concealed in adults. Animal with tentacles conical, the eyes placed externally at the base of tentacles, foot broad, operculum none; mantle very ample, reflected upon the shell at the sides.

*Porcelain shells.* A very numerous genus (about 200 species are known), which is defined very naturally. The shell of the young animal differs much from that of the adult; it is thin, differently coloured and without teeth at the aperture, the wreaths also being then visible (see above, p. 687, and compare the figure of *Cyprœa exanthema* in the young state, *Encycl. méth., Vers.* Pl. 349, or in BLAINV. *Malac.* Pl. 30, fig. 2).

Sp. *Cypræa Argus* L., RUMPH. Tab. 38, fig. D, *Encycl. méth., Vers.* Pl. 350, fig. 1;—*Cypræa variolaria* LAM., CUV. *R. Ani., éd. ill., Moll.* Pl. 49, fig. 4 (a fig. of the animal with the shell transferred from QUOY et GAIMARD *Voy. de l'Astrol.*);—*Cypræa moneta* L., RUMPH. *Amb. Rariteitk.* Tab. 39, fig. C, *Encycl. meth., Vers.* Pl. 356, fig. 3, a species known by the name of *Kauri (Cowry)*, which serves for small money in some countries of Africa and India.

Section III. Cavity for respiration furnished with a network of vessels running on its walls, opening externally by an aperture of mantle.

Family XI. *Pneumonica* (*Cœlopnoa* SCHWEIG.). Hermaphrodite molluscs breathing air, most of them terrestrial, others aquatile, ascending to the surface of the water for respiration. Some naked, others testaceous.

This division of Molluscs is treated of at length in the illustrated work of DE FÉRUSSAC, *Histoire natur. des Mollusques terrestres et fluviatiles*, Paris, 1819 and foll. DESHAYES, after the death of FÉRUSSAC, began the continuation which was completed in 1851.

I. *Operculum.*

*Ampullacera* QUOY and GAIM.

*Note.*—Shell of *Ampullaria*. Head bilobed, with rounded lobes in place of tentacles. Here belong the species of *Ampullaria* (*Ampull. avellana* and *Amp. fragilis*) of LAMARCK. The genus seems to me to be of uncertain position.

II. *Operculum none true.*

Phalanx I. Eyes at the base of tentacles. Two tentacles only. The most aquatic.

*Ancylus* GEOFFR. Shell thin, obliquely conical, with apex acute, inflected posteriorly. Aperture oval, with margins very simple. Creeping body entirely covered by shell.

Sp. *Ancylus lacustris* MUELL., *Patella lacustris* L., PFEIFFER *Schn.* I. Pl. IV. fig. 46;—*Ancylus fluviatilis, Patella fluviatilis* GMELIN, BLAINV. *Malacol.* Pl. 48, fig. 6, STURM *Deutschl. Fauna*, VI. Heft 4, Tab. 9, PFEIFFER l. l. fig. 44.

Concerning the place of this genus in the natural arrangement opinions are at variance. TREVIRANUS thought, from the anatomical investigation of *Ancyl. fluviatilis*, that the genus might indeed have some affinity with *Lymnæus*, but still does not belong to the *pneumonica*, because on the left side, between the mantle and the border of the ventral disc, a gill is situated

in form of a long leaf. TREVIRANUS, accordingly, compares this animal with *Pleurobranchus*, but remarks at the same time that in this last genus the gill lies on the right side, and has many transverse folds, whilst that of *Ancylus* presents an entirely smooth surface. (*Zeitschr. für Physiologie*, IV. 2, 1822, s. 192—197, Taf. XVII.). TROSCHEL refers *Ancylus* to the *Hypobranchiata* (see WIEGMANN'S *Archiv*, 1838, II. s. 285). But since, however, VOGT has subsequently remarked, that these animals appear to breathe air alone, and that it has by no means been proved that the leaf-like organ is really to be regarded as a gill (MUELLER'S *Archiv*, 1841, s. 25—28), we still think that *Ancylus* must remain amongst the *pneumonica aquatilia*.

*Limnæus* CUV., *Lymnæa* LAM. Tentacles broad, short, compressed, triangular, not retractile. Eyes placed between the bases of tentacles. Shell thin, oblong, sometimes turrite; spire exsert. Aperture entire, longitudinal. Labrum acute, ascending towards columella and forming an oblique fold.

*Mud-snail.* These animals have a thin shell; the last wreath is very wide and round. On the right side of the animal is the respiratory aperture, the walls of which can be elongated as a tube, and thus extend above the water. Such is the case when the animal respires at the surface of the water, with the foot or the ventral disc turned upwards. The apertures of the sexual organs lie far apart. Under the right feeler is the aperture which transmits the penis, under the respiratory aperture that of the female organs. To this it is to be ascribed that in copulating one individual is connected with two others, one of which impregnates it whilst the other is impregnated by it. In this way, hanging together, they often form several long chains. (VON BAER has, however, observed self-impregnation also in *Limnæus auricularis*, MUELLER'S *Archiv*, II. 1835, s. 224.) These snails live on water-plants.

Compare SWAMMERDAM *Bijbel der Nat.* I. bl. 164—169, Tab. IX. fig. 4;—CUVIER *Ann. du Mus.* VII. pp. 185—193, Pl. X. figs. 2—11, *Mollusq., Mém.* No. 14;—STIEBEL *Dissert. inaug. sistens Limnei stagnalis Anatomen*, Gottingæ, 1815; 4to, c. tabulis 2.

Sp. *Limnæus stagnalis*, *Helix stagnalis* L. (703), BLAINV. *Malac.* Pl. 37, fig. 1; PFEIFFER *Schn.* I. Tab. IV. fig. 19, &c.

Sub-genus *Amphipeplea* NILSSON. Mantle involving shell. Shell subglobose; spire obtuse, scarcely prominent.

Sp. *Limnæus glutinosus* DRAPARN.

*Physa* DRAPARN. (*Bulinus* ADANS.) Tentacles slender, setaceous, long. Foot long, anteriorly rounded, posteriorly narrow, acute. Margins of mantle sometimes fimbriate, reflected over shell. Shell oval or oblong, often left-handed; aperture longitudinal, produced anteriorly, enlarged.

Sp. *Physa fontinalis* DRAP., *Bulla fontinalis* L., STURM *Deutschl. Fauna*, VI. Heft 4, Tab. 10;—*Physa hypnorum* DRAP., *Bulla hypnorum* L., STURM l. l. Tab. 11, CUV. *R. Ani., éd. ill., Moll.* Pl. 26, fig. 5.

*Planorbis* BRUG. Tentacles setaceous, very long. Foot short. Shell disciform, with all the wreaths conspicuous on both sides. Aperture almost lunate, with margin not reflected.

These snails live with *Limnæus* in stagnant fresh water, and have, however remarkably the external form differs, almost the same internal structure as the species of that genus. Compare SWAMMERDAM *Bijbel der Nat.* I. bl. 186—189, CUVIER *Ann. du Mus.* VII. pp. 194—196, Pl. X. figs. 12—15, *Mollusq., Mém.* 14.

Sp. *Planorbis corneus, Helix cornea* L., BLAINV. *Malacol.* Pl. 37 bis, fig. 3, STURM l. l. Tab. 4, GUÉRIN *Iconogr., Moll.* Pl. 7, fig. 2, &c.

*Auricula* LAM. (spec. from genus *Voluta* L.). Two conical tentacles. Shell oval or oblongo-ovate. Aperture longitudinal, with labrum often reflected. Columella folded.

To this genus belong species that live on land, although elsewhere these molluscs, like *Helix*, are distinguished by four tentacles. Different genera have been adopted here, as *Carychium* MUELL. and *Scarabus* MONTF., *Scarabæa* CUV. This last genus is distinguished by a shell longitudinally compressed into a margin on each side (carinated).

Compare DESHAYES *Dict. univers. d'Hist. nat.* I. 1842, pp. 345—348, the article *Auricule;* TROSCHEL in WIEGMANN'S *Archiv*, 1838, I. pp. 202—208, on *Scarabus*, and REEVE on the same sub-genus, *Ann. of Nat. Hist.* IX. pp. 218—221.

Sp. *Auricula midæ, Voluta Auris Midæ* L., D'ARGENV. *Conchyl.* Pl. 10, fig. G, *Encycl. méth., Vers.* Pl. 460, fig. 6, GUÉRIN *Iconogr., Mollusq.* Pl. 7, fig. 7, QUOY et GAIM. *Astrolabe, Zool.* Pl. 14 (fig. with the animal, transferred in CUVIER *R. Ani., éd. ill., Moll.* Pl. 27, fig. 1); New Guinea, not far from the shore; *Auricula judæ, Voluta Auris Judæ* L., BLAINV. *Malacol.* Pl. 38, fig. 1;—*Auricula scarabæa, Helix Scarabæus* L., *Scarabus imbrium* MONTF., CHEMN. Tab. 136, figs. 1249, 1250, REEVE *Ann. of Nat. Hist.* l. l. Pl. 4, fig. 11; lives in the E. Indies, in woods at the roots of trees, &c.

Phalanx II. Eyes at the point of tentacles. Tentacles most frequently four; two superior placed more backwards, larger; inferior short (sometimes obsolete). *Mollusca pneumonica terrestria aut amphibia.*

A. *Testacea* (*Helicina*).

*Pupa* DRAP., LAM. (spec. of *Turbo* L.). Animal with inferior tentacles very short or none (*Vertigo* MUELL.). Shell elliptical or cylindrical, with aperture semirotund, in most dentate.

Sp. *Pupa muscorum* LAM., *Turbo muscorum* L., PFEIFFER *Schn.* I. Tab. 3, figs. 17, 18;—*Pupa mumia* LAM., BLAINV. *Malac.* Pl. 38, fig. 5, &c. Add genus *Chondrus* CUV.

*Clausilia* DRAP., LAM. (species of *Turbo* L.). Animal with inferior tentacles very short. Shell very often thin, fusiform, with apex somewhat obtuse. Aperture subovate, with margins at each side connate, reflected. (In the last wreath in most a testaceous lamella adhering to columella by a thin elastic pedicle[1].)

This genus is much allied to *Pupa*, and may, as DESHAYES decides, be united with it. In most of the species the shell is left-handed. Such is the case with all the European species, which are small, and are found on trunks of trees, on the ground amongst fallen leaves and on stones. Sp. *Clausilia rugosa* DRAP., *Helix perversa* MUELL., PFEIFFER *Schn.* I. Tab. III. fig. 30. Here also belongs the genus *Cylindrella* PFEIFFER.

*Bulimus* DESHAYES, nob. (*Bulimus* and *Achatina* LAM., species of genus *Bulimus* SCOPOLI, BRUG.). Animal with four distinct tentacles, and foot lanceolate posteriorly. Shell ovate, more rarely oblong, cylindrical, with last turn rather large, and apex of spire somewhat obtuse. Aperture longitudinal. Columella smooth.

*Achatina* LAM. Columella truncated towards the end, not continuous with margin of aperture. Labrum always acute.

Sp. *Bulimus virgineus*, *Bulla virginea* L., D'ARGENV. *Conchyl.* Pl. 11, fig. N, BLAINV. *Malac.* Pl. 38, fig. 2, CUV. *R. Ani., éd. ill., Moll.* Pl. 25, fig. 4; South America;—*Bulimus columna*, *Helix columna* GMEL., *Encycl. méth., Vers.* Pl. 459, fig. 3, BLAINV. *Malac.* Pl. 40, fig. 3, &c.

*Bulimus* LAM. Columella not truncated, continuous with margin of aperture. Labrum often reflected, incrassated (spec. of *Helix* L.).

Sp. *Bulimus lubricus* BRUG. (*Helix subcylindrica* L.?), STURM *Deutschl. Fauna*, VI. Heft 4, Tab. 4, PFEIFFER *Schn.* I. Tab. 4, fig. 6. *Bulimus citrinus* BRUG., *Helix perversa* L., D'ARGENVILLE *Conch.* Pl. 9, fig. G, MOUSSON Tab. XX. fig. 5, &c.

*Helix* BRUG. (Species from genus *Helix* L.). Four distinct tentacles. Shell orbicular or depresso-conical. Aperture broader than long, lunate, with penultimate wreath prominent internally.

Comp. DESHAYES *Dict. classiq. d'Hist. nat.* VIII. 1825, pp. 74—89, *Encycl. méth., Vers.* II. pp. 188—266, under *Helix*.

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[1] Compare on this part, to which the genus *Clausilia* owes its name, J. E. GRAY in *Annals of Nat. Hist.* V. p. 243. It is no *operculum*, but rather a modification of the tooth-like prominence at the aperture of the shell occurring in many molluscs.

† *Aperture turned upwards, dentate on each side.*

*Anostoma* FISCHER, LAM.

Sp. *Helix ringens* L., D'ARGENV. *Conchyl.* Pl. 28, figs. 13, 14, BLAINV. *Malac.* Pl. 39, fig. 4; habit. in E. Indies[1].

† † *Aperture inclined downwards, shell at the periphery carinate or subcarinate, mostly depressed. Labrum often reflected, sometimes dentate.*

*Carocolla* LAM.

Sp. *Helix Lapicida* L., PFEIFFER *Schn.* I. Tab. II. fig. 26;—*Helix Carocolla* L., D'ARGENV. *Conch.* Tab. 8, fig. D, GUÉRIN *Iconogr., Moll.* Pl. 6, fig. 1; from the E. Indies, &c.

† † † *Aperture inclined downwards. Shell rounded at the margin, most frequently subglobose.*

*Helix* LAM.

Sp. *Helix Pomatia* L., STURM *Deutschl. Fauna*, VI. Heft I, PFEIFFER *Schn.* I. Tab. II. fig. 9, CUV. *R. Ani., éd. ill., Moll.* Pl. 21. The *Vineyard-Snail, le grand Escargot.* The name *Pomatia*, from Πῶμα, cover (*cochlea opercularis*), was given to this animal on account of the closure of the aperture of the shell in winter that occurs in this and other species. In autumn the animal retracts itself within the shell, and then a false operculum (*epiphragma*) is secreted, which is pushed off in spring when the snail again creeps out of its house. During the winter these snails in our temperate climate take no food, but lie asleep; in like manner, in tropical regions the species of this genus in the dry months fall into a state of insensibility.

For the anatomical particulars we refer to SWAMMERDAM *Bijbel der Nat.* I. pp. 97—147; CUVIER *Ann. du Mus.* VII. 1806, pp. 140—184, *Mollusq., Mém.* No. 11; and WOHNLICH *Diss. anat. de Helice pomatia cum tab. æn.* Wirceburgi, 1813, 4to. In all the species of *Helix* there is found in the neighbourhood of the sexual organs a thick-walled pear-shaped purse, in which a dart-shaped calcareous stile is contained; this organ is annually renewed, just like the cover of the mouth of the shell.

*Helix adspersa* MUELL., STURM *Deutschl. Fauna*, VI. Heft VI. Tab. 4; this species nearly attains the size of the preceding;—*Helix nemoralis* L., STURM l. l. Heft 2, &c. On this and other native species, the figures of PFEIFFER and STURM may be compared. This genus is also remarkably numerous in exotic species.

*Succinea* DRAP. Animal larger than shell, not entirely covered by it, with four tentacles short, especially the inferior. Shell ovate, with spire short; aperture ample, longitudinal, with labrum acute, columella short.

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[1] Some fossil shells from the tertiary formations are known, which also have an aperture turned upwards; but this is round and not toothed. They form the genus *Strophostoma* DESHAYES, and might be brought to *Cyclostoma* (p. 891). See DESHAYES *Mém. sur le Strophostome, Ann. des Sc. nat.* XIII. 1826, pp. 282—287.

Sp. *Succinea amphibia* DRAP., *Helix putris* L., BLAINV. *Malac.* Pl. 38, fig. 4, STURM *Deutschl. Fauna*, VI. Heft 1, PFEIFFER *Schn.* I. Tab. I. fig. 4, Tab. III. figs. 36—38; very common in canals, on water-plants, &c.

*Vitrina* DRAP., LAM. (*Helicolimax* FÉRUSS.). Body elongate, limaciform; mantle with an appendage reflected over the shell; tentacles four, two inferior very short. Shell depressed, small, very thin, imperforate, with spire short. Aperture large, rotundato-lunate.

Comp. D'AUDEBARD FÉRUSSAC *Naturforscher*, Vol. 29, pp. 236—241, Tab. I.

Sp. *Vitrina pellucida* DRAP., *Helix pellucida* MUELL., *Vitrina beryllina* PFEIFFER, STURM *Deutschl. Fauna*, VI. Heft 3, Tab. 16, GUÉRIN *Iconogr., Moll.* Pl. 5, fig. 3; on water-plants, and on the ground amongst mosses and fallen leaves.

B. *Nuda.* Shell none or concealed beneath the mantle, small. *Limacina.*

*Limax* L. Tentacles four.

*Parmacella* CUV. Mantle placed upon the back, emarginate in the middle of right margin, including posteriorly the shell spired obsoletely. Orifice of respiration and vent below a fissure at the right side of mantle, generative aperture between the tentacles of the right side.

Sp. *Parmacella Olivierii* CUV., *Ann. du Mus.* V. Pl. XXIX. figs. 12—15; *Mollusq., Mém.* XII.; BLAINV. *Malacol.* Pl. XLI. fig. 3, GUÉRIN *Iconogr., Mollusq.* Pl. V. fig. 5, &c.

*Testacella* LAM. Respiratory cavity and vent above the posterior extremity of body. Small mantle situated in the same place, including a very small shell spired obsoletely at the apex. Aperture of generative organs below the larger tentacle of right side.

Sp. *Testacella haliotidea* CUV., *Ann. du Mus.* V. p. 440, Pl. XXIX. figs. 6—11, *Mollusq., Mém.* XII., BLAINV. *Malacol.* Pl. XLI. fig. 2, GUÉRIN *Iconogr., Mollusq.* Pl. V. fig. 4.

*Vaginulus* LAM.

*Limax* LAM. Body oblong, naked, creeping, convex on back, furnished anteriorly with a coriaceous, subrugose mantle, and below with a longitudinal flat disc. Branchial cavity under the shield or small mantle, in the anterior part of back. Respiratory orifice and vent placed in the right side; generative orifice beneath the right tentacles.

*Ground-slug, Path-slug.* The mantle is here small and in some contains a calcareous grit, in others a small shell. At the hinder end of the body is a small aperture, from which adhesive mucous threads proceed. Here the viscera are placed in the body and not in the mantle, as in the snails (*Helices*). The internal structure however has much resemblance to that of the *Helices;* but the calcareous dart and the purse that contains it are here absent.

These animals live on herbs, fruits, &c., and dwell in moist places.

Comp. CUV. *Ann. du Mus.* VII., *Mollusq., Mém.* XI.

Sp. *Limax cinereus* MUELL., *Limax maximus* L., BLAINV. *Malacol.* Pl. XLI. fig. 5; STURM *Deutschl. Fauna,* VI. Heft 2;—*Limax ater* L., STURM l. l. Heft 1.; *Limax rufus* L., STURM l. l. Heft 1., BLAINV. l. l. fig. 6, &c.

*Onchidium* (BUCHANAN) CUV., *Peronia* BLAINV. Tentacles four. Body oblong, creeping, marginate everywhere by thick mantle. (Orifice for the passage of penis under the right tentacle; vent, respiratory foramen and aperture of female genitals beneath the posterior extremity of mantle. Veil emarginate over the mouth, or two auriform appendages at the sides of mouth.)

Half a century ago a slug-like animal was first discovered by BUCHANAN in Bengal, on the leaves of *Typha elephantina,* to which, on account of the many small tubercles on the back, he gave the generic name cited above (derived from ὄγκος). See *Linn. Trans.* V. pp. 132—134. The animal discovered by B. has not, to my knowledge, been described more particularly by any later observer; the animals to which CUVIER gave this generic name live in the sea near the shore, and also come on land. According to EHRENBERG (*Symbol. physic., Evertebr.* I.) there are seen behind on the back arborescent appendages which contract when the animal is on dry land and which may be regarded as gills. This animal may thus form the transition to the *Gymnobranchiata* and have an affinity to *Doris.*

Sp. *Onchidium Peronii* CUV., *Ann. du Mus.* V. pp. 37—51, Pl. VI.; *Moll., Mém.* No. 13, *Peronia mauritiana* BLAINV. *Malacol.* Pl. 46, fig. 7.

*Note.—Peronia ferruginea* LESS. *Ill. de Zool.* Pl. 19, is it an *Onchidora?*

## ORDER III. *Cephalopoda.*

Molluscs with distinct head, the organs of motion, tentacles or arms, crowning the mouth. Body sacciform, open anteriorly. Sexes distinct. Respiration branchial. Animals all marine, testaceous or naked.

*Cephalopods.* These animals present clear vestiges of an internal cartilaginous skeleton. In the head is found, in most, as in *Sepia, Loligo* and *Octopus,* a cartilaginous ring, through the aperture of which the œsophagus passes and of which the uppermost part covers

the cerebral ganglion, the lowest contains the auditory organs, and the lateral parts, broad and excavated like a cup, receive the eyes. The orbits are guarded in front by two elongated cartilaginous plates, which are attached by their base to the cartilaginous ring and elsewhere are extended freely over those cavities. In the *Sepia* there is an additional triangular cartilage, of which the point is attached to the ring, the base turned towards the arms, and to which the muscles of the arms are affixed. In *Sepia* and *Loligo* there are further found two catilaginous plates on the back, and, on each side of the body, an elongated flat cartilage which supports the lateral expansions of the mantle or the fins[1]. In the *Nautilus* there is only one cartilage present in the head, which lies beneath the œsophagus, but does not enclose this annularly, and is prolonged on each side to the funnel. The eyes, which in this genus are placed on pedicles at the side of the head, are not protected by this cartilage.

The head of these molluscs is round and broad and separated by a constriction, as by a neck, from the body. Around the mouth are placed in most eight or ten arms; in *Nautilus*, on the contrary, several membranous sheath-like appendages, perforated internally, in which thin cylindrical tentacles, capable of extension and retraction, are inclosed. Where eight or ten arms are present, eight of them have constantly a somewhat conical form and stand in a circle round the mouth. On the upper surface, that which faces towards the mouth, these eight arms are covered with numerous suckers, by which they attach themselves to different bodies. (In the ten-armed two are placed on the outside beyond the circle of the other eight on the ventral surface, and can by retortion be drawn entirely within the body. Already had ARISTOTLE distinguished these two from the other arms under the name of *proboscides*.) The arms are hollow internally, for the passage of the artery and nerve; radiating muscular fibres run from the middle outwards, and on the surface is a layer of circular and longitudinal muscular fibres, by which all the various motions of retraction, contraction, flexure and convolution become possible, which, on the seizure of prey, are executed by these organs.

Under the head is situated a conical organ, which is open at the extremity, the funnel (*infundibulum*) formed by an extension of the mantle and provided with muscular walls. In *Nautilus* it has two

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[1] See C. A. SCHULTZE in MECKEL'S *Archiv für die Physiologie*, IV. 1818, s. 334—338, Tab. IV. fig. 1.

margins, like a rolled leaf, free beneath, which are thrown one over the other; in the other Cephalopods it opens at the anterior extremity alone. Below, this funnel passes into the cavity within which the gills are situated, and into which the terminations of the sexual organs and of the intestinal canal open. The contraction of the funnel forces out the water at its opening below the head. Before the opening there is usually placed a valvular organ (not unlike an *epiglottis*), by which the reflux of the water is prevented.

The mouth lies in the middle between the arms, surrounded by a circular fold of skin. Here are seen two large, curved, horny jaws, which resemble in some degree the bill of a parrot, and of which the lower overlaps the upper and smaller. Between the jaws is placed a membranous tongue, which is soft at the point and beset with papillæ, but elsewhere is covered with hard, horny plates and spines. In the sac of the mantle most of the viscera (with exception of the gills) are situated in a proper cavity, which is distinct from that of the gills that opens externally through the funnel.

The respiratory organs are two or four gills, which, pointed conically, run obliquely upwards, and are situated, one or two on each side, in the base of the sac, which terminates in the funnel. They are affixed here to a fleshy, projecting margin, and consist of membranous leaflets, incised at the edge, each of which is affixed by a separate stalk to the projecting margin. In those that have only two gills, a venous heart is situated at the base of each of these; in the *Nautilus*, that has four gills, these two venous hearts are not present. On the large venous stems which conduct the venous blood towards the gills, spongy appendages, usually of a brown-yellow colour, united in bundles, and sometimes subdivided blind *folliculi*, which we noticed above (p. 760) as kidneys, are situated. The cavities in which these veins lie, are washed by water that has a free access to them through special apertures in the branchial cavity.

The sexual organs, in both sexes, are situated in the base or posterior extremity of the visceral sac. The *ovarium* is in all single, although in many two oviducts are present, which then, however, arise from a short common canal. This ovary consists of a sac with thick walls, on the inside of which, the eggs inclosed in proper capsules, are affixed by pedicles. For the secretion of the envelop of the eggs there is a glandular organ, which in *Octopus* surrounds each oviduct, or the walls of the oviduct itself are thickened towards the extremity by a glandular tissue which supplies the same secretion. One or two glands composed of many laminæ, which however are

wanting in *Octopus*, are present in females, without any connexion with the oviduct, and probably secrete an external covering, or an adhesive substance, by which the eggs are attached to each other. The *testis* in the male agrees for the most part with the ovary in external form and in situation. It presents a sac in which a bundle of glandular tubes that secrete the seed is found. The efferent duct is narrow and very tortuous, and afterwards passes into a wider canal with internal folds, into which also an elongated gland (*prostata?*) situated laterally effuses its secretion. This canal terminates in a muscular purse with thin walls, in which lie whitish cylindrical bodies, about half an inch, and sometimes much more in length, and which move when they are moistened long after the death of the animal: which motion NEEDHAM has fully described[1].

> NEEDHAM compares these singular little machines, as he names the organs, with the *Spermatozoa* of other animals, from which however they differ in their size and their composite structure. This is not exactly the same in the various genera, yet it agrees in the chief point that in the cylindrical body an elongated sac with thin walls and filled with a white fluid (*sperma*) is situated, and extends to one of its extremities, whilst at the other end there is a filament, turned spirally, and contained in a long thin tube, which, after a pear-shaped expansion, is attached by a short pedicle to the elongated sac at the other extremity. On contact with water the cylindrical body is opened, probably by endosmose, and this occasions the expulsion of the spiral organ which draws out with it the attached sac. Within the sac is contained a white *sperma* with cylindrical *spermatozoa* terminating in a long fine filament. The *Needhamian* bodies are thus not *spermatozoa*, but they contain *spermatozoa*; they are *seed-machines*, *capsulæ seminis* or *spermatophores*, as MILNE EDWARDS has named them[2].

The male Cephalopods have a short, very thick, conical and perforate penis, which is situated at the side of the rectum at the same part where the extremity of the oviduct lies in the females attached

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[1] *Nouvelles découvertes faites avec le Microscope*, par T. NEEDHAM, *traduites de l'Anglois*. Leide, 1747, 8vo, pp. 44—67. London, 1745. Hence, also, these organs are named *Needhamian* bodies, although they had been previously observed by SWAMMERDAM (*Bijbel der Nat.* Tab. LII. figs. 6, 7). Some regard these little cylinders as real animals; see G. C. CARUS *Needhamia expulsoria sepiæ officinalis, beschreiben und abgebildet; Nov. Act. Acad. Cæs. Leop. Carol.* XXIX. Pl. I. 1839.

[2] Compare A. KROHN, FRORIEP'S *Neue Notizen*, XII. Bd. § 17—23, October, 1839, PHILIPPI in MUELLER'S *Archiv*, 1839, § 310—312, Taf. XV.; PETERS ibid. § 98—100, and MILNE EDWARDS *Ann. des Sc. natur.*, 2e Série, XVIII. 1842, pp. 321—347, with many figures. In a well-preserved specimen of a male *Nautilus* I found the whole *bursa Needhami* (*vesicula seminalis*) filled by a single cylindrical, long, and tortuous canal, within which was a fine spiral filament.

in the gill-sac. Whether an introduction of this organ into the funnel of the female takes place, is not sufficiently cleared up.

[In certain genera of Cephalopods there is a very remarkable accessory organ of propagation in the males, which we now proceed to notice. Amongst the doubtful genera of Entozoa (p. 188) *Hectocotylus* is recorded. It was first noticed by DELLE CHIAJE in *Argonauta*[1], and by him referred to the genus *Trichocephalus* by the name of *Trichocephalus acetabularis*. Afterwards what was supposed to be another species of the same genus was detected in *Octopus granulosus* LAM. by LAURILLARD, and described by CUVIER[2]. This presented more than 100 suckers, whereas that of DELLE CHIAJE had only 35, whence it was named by CUVIER *Hectocotyle* from ἑκατόν. KOELLIKER[3], from his examinations of the *Hectocotylus* of *Argonauta*, and of another discovered by VÉRANY in *Tremoctopus violaceus*, declared it to be the male individual of these animals respectively, and not a parasite. This opinion was afterwards shewn to be unfounded, for VÉRANY[4] found in several specimens of a Cephalopod, called by him *Octopus Carena* (male *Oct. granulosus* LAM.), that the 3rd arm on the right side was longer and thicker than the rest, and had a bladder at its extremity, whilst PHILIPPI, in a specimen examined by him, saw the same arm fall off on being touched, and found it to resemble exactly the *Hectocotylus* described by CUVIER.

At an early period the *Hectocotylus* arm is developed in its future position in a pediculated vesicle in which it is rolled up. The vesicle alone contains chromatophores[5]. As the development proceeds, the containing vesicle or bladder shews a fissure on that side which is towards the mouth of the Cephalopod from which the *hectocotylus* emerges; but since the latter is attached throughout a considerable portion of its length to the inner surface of the other side of the bladder, this last is turned inside out when the *hectocotylus* has escaped, and continues to be attached to it on its dorsal surface. The structure of the *hectocotylus* is the same as that already described of the other arms, except that in the central canal is an elongated muscular pouch, closed at the near end and terminating in a fine tube, and that there is a filament at the end of the *hectocotylus* (which has

[1] *Memorie*, II. p. 225, Pl. XVI. fig. 1.
[2] *Ann. des Sc. nat.* XVIII. 1829, pp. 147—156.
[3] *Ann. of Natural History*, 1845.
[4] *Mollusques méditerranéens*, 1ère Partie. Gênes, 1847—1854, s. 34 and 126, Pl. 41.
[5] See p. 824.

been developed in its own proper vesicle within the larger bladder, and of which the remains continue attached at the extremity of the *hectocotylus* after it has allowed the filament to escape). The filament is tubular, its cavity is continuous with that of the *hectocotylus*, and is open at its extremity. The tube of the elongated pouch runs in the central cavity of the *hectocotylus* and of its continuation, the filament, and opens at the extremity of the latter externally. The pouch or sac is found, when the *hectocotylus* is fully developed, to contain a *spermatophore*, and it was the presence of *spermatozoa* and of an organ apparently for the secretion of them in the interior of the *hectocotylus*, when found attached to the respiratory cavity of the *Argonauta*, that induced KOELLIKER to suppose the *Hectocotylus* to be the male of the *Argonauta*. H. MUELLER found this *Hectocotylus* in its state of imperfect development on that male, which is much smaller than the female, and has no shell[1]. The hectocotylus arm is the second of the left side in *A. Argo*, the third of the right side in *Octopus granulosus*, (*Tremoctopus Carena* VÉR.) whilst the *hectocotylus* only, and not the male of *Tremoctopus violaceus* DELLE CHIAJE, has hitherto been discovered.

The sexual organs of the hectocotyliferous males are constructed on exactly the same plan as those of the males of ordinary Cephalopods. The *vas deferens* opens at last into the respiratory sac, so that the idea of a communication between it and the sac of the hectocotylus arm, entertained by some, is untenable. How then is the spermatophore transferred to this sac? VOGT[2] thinks that the spotted pocket (the bladder in which the *hectocotylus* was originally developed, and which is now turned inside out, with a fissure through which the arm has passed) serves as a receptacle for the spermatophore, which has been transferred to it by the long filament of the *hectocotylus* embracing it; at the same time he denies the existence of the muscular sac in the interior. LEUCKART[3], however, has established the existence of this last, and has found a communication between the spotted bladder and the side of the muscular sac attached to it, namely a canal by which they communicate. It is not

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[1] See H. MUELLER *Ueber das Männchen von Argonauta Argo und die Hectocotylen*, SIEBOLD u. KOLLIKER'S *Zeitschr. für wissensch. Zool.* IV. 1852, pp. 1—35, Pl. I. *ibid.* pp. 346—359.

[2] VÉRANY et VOGT *Sur la nat. des Hectocotyles*, *Ann. des Sc. nat.* T. XVII. pp. 148, 191, Pl. 6—9, at p. 155.

[3] LEUCKART *Die Hectocotylie von Octopus Carena*, *Zool. Untersuch.* Heft III. Giessen, 1854, pp. 91—109, Tab. 2, at p. 103.

impossible that the spermatophore may be transferred in some cases, in the way supposed by VOGT, but not always. For the spermatophore has been found in the *hectocotylus*, whilst the filament was yet inclosed in its proper sac. In this case the other arms may have effected the transfer, as LEUCKART conjectures. After it has been brought thus far, the propulsive force of the spiral portion of the spermatophore must be supposed to come into play in order to begin the passage through the tube of communication with the muscular pouch of the *hectocotylus*, whose walls are also muscular. The filament at the end of the *hectocotylus* has been very generally supposed to act as a penis. H. MUELLER found as many as six of them within the capsule of the ovary in *Argonauta Clio*, that had been broken off[1], and two others in one of the oviducts, so that no fewer than eight males would seem to have fecundated this individual.

It is presumed that when the *hectocotylus* arm has been cast off, it may be successively reproduced.]

The eggs are laid in heaps, or are connected with each other in clusters by pedicles and an adhesive substance. In this respect great variety prevails in the different genera. In *Loligo*, many eggs are united in strings of a gelatinous substance; in *Sepia* they are very large and surrounded by a horny dark envelop, which is produced into a pedicle at one extremity, and by which the eggs are attached to each other, or to foreign bodies.

In the development of the *embryo*, when the egg has been laid, grooves are formed in that part of the yolk where was previously the germinal vesicle, and which do not extend over the whole yolk. Here the *embryo* afterwards appears as a disciform germ, at first flat and round, in which, at an early period, different inequalities indicate the first existence of the mantle, of the eyes, and of the funnel, formed at first of two separate halves. This germ-disc begins to swell gradually in the center, extends itself constantly further towards the circumference, and finally surrounds the entire yolk. In this way a part of the yolk-sac between the arms at the ventral surface is included in the mantle, so that afterwards an internal as well as an external yolk-sac is found, the two being connected by a narrow pedicle[2].

[1] [*Op. cit.* p. 354.]

[2] Formerly it was supposed that the yolk-sac is connected with the mouth by means of this pedicle (CAVOLINI); CUVIER presumed a connexion with the œsophagus; see his memoir *sur les œufs de Seiches, Nouv. Ann. du Mus.* I. 1832, pp. 153—160, Pl. 8. The chief work that we now possess on the development of these animals and from which we have borrowed what has been announced, is A. KOELLIKER *Entwickelungsgeschichte der Cephalopoden*, Zurich, 1843, 4to.

The nervous system is largely developed in the *Cephalopoda*, and in most of the genera the central mass for the head (the cerebral mass) is enclosed in the cartilaginous ring, which we have already noticed. Beneath the œsophagus a considerable nerve-mass is situated, which in *Nautilus* is divided into two transverse bands, one in front of the other. From the anterior portion of this central mass (or from the first of the two half-rings, situated under the œsophagus in *Nautilus*) the nervous trunks for the arms arise, or for the tentacles surrounding the head. In *Octopus*, *Sepia*, and *Loligo*, these anterior portions form on each side a large, flat ganglion, from the anterior margin of which the brachial nerves of that side radiate (*ganglions en patte d'oie* CUVIER). From the posterior portion arise at the side thick nervous stems for the mantle, which in *Loligo*, *Sepia*, *Octopus*, &c. terminate in two large *ganglia*, from which the nerves radiate at acute angles; in *Nautilus* these lateral *ganglia stellata* are wanting. In addition there arise from the middle of the posterior margin of this portion two nervous trunks, at first laid close together, from which the nerves for the viscera arise. From the portion situated above the œsophagus nerves arise for the muscular mass that surrounds the jaws, or these come from the ganglion of the sympathetic system placed above the œsophagus (*ganglion pharyngeum*) as in *Sepia* and *Loligo*. From the lateral commissures of this portion, by which it is connected with the central mass situated beneath the œsophagus, the two remarkable optic nerves arise, which terminate in kidney-shaped ganglia; lower down arise the two short auditory nerves which penetrate into the cartilaginous ring of the head. The sympathetic nervous system has a ganglion (*ganglion labiale*) seated under the œsophagus, and one on the stomach formed by the union of two nervous stems.

On the organs of sense in this order, what we have stated above (pp. 766—768) may be referred to. The skin of the Cephalopods is distinguished by a change of colour exhibited during the life of the animal, and depending upon a peculiar stratum of saccules filled with pigment-granules (*chromatophores* of SANGIOVANNI and WAGNER), which are connected by a delicate, elastic, membranous tissue. These organs lie immediately under the cuticle, and by alternate contraction of the vesicles, containing red, blue, or yellow colouring matter, a lively play of colour arises in definite situations, especially in *Loligo* and *Argonauta*[1].

[1] Compare R. WAGNER in OKEN'S *Isis*, 1833, pp. 159—161, WIEGMANN und ERICHSON'S *Archiv f. Naturgesch.* 1841, s. 35—38.

On this order, which many writers separate as a distinct class from the rest of the Molluscs, compare,

CUVIER *Mémoire sur Cephalopodes et sur leur anatomie. Mollusq., Mém.* I. with 4 plates.

R. OWEN *Cephalopoda* in TODD'S *Cyclopædia*, I. pp. 517—562.

FÉRUSSAC et D'ORBIGNY *Monographie des Cephalopodes cryptodibranches.* Paris, 1834—1843. 18 livraisons.

## A. *Tetrabranchiata.*

Family XII. *Nautilacea.* Branchiæ four. Funnel cloven beneath, with two lamellæ covering each other obliquely. Tentacles numerous, contractile, vaginate. Shell external revolute, spiral, polythalamous, hard; with septa perforated in the middle; last chamber ample, including the animal, with a membranous tube (siphon) produced from the posterior part of the abdominal sac through the foramina of the septa into the other chambers.

*Nautilus* L. (in part), LAM.

Sp. *Nautilus Pompilius* L., RUMPH. *Amb. Rariteitk.* Tab. XVII. figs. A, C, BLAINV. *Malacol.* Pl. IV. fig. 8; GUÉRIN *Iconogr., Mollusq.* P. I. fig. 7; the *pearly nautilus;* the shell attains a size of more than ½ foot; on the inside it is whitish with a pearly lustre, on the outside milk-white, with orange or red-brown stripes. This species, the only one of the seventeen species recorded by LINNÆUS that has remained in the genus *Nautilus*, is found in the Indian Ocean, the Islands of the Moluccan Archipelago, &c. *Nautilus umbilicatus* LAM., in the shell of which the last wreath does not cover that which precedes it, is in other respects comformable to the above.

Notwithstanding the shell is not altogether rare, the animal of the pearly *Nautilus* was, until within the last few years, known only from a very imperfect figure of RUMPHIUS. OWEN was the first who gave a good description and a careful anatomy of this interesting animal (*Memoir on the pearly Nautilus, with illustrations of its external form and internal structure.* London, 1832, 4to). Besides the characters already given above, it is distinguished from the rest of the Cephalopods now living by the absence of the *Ink-sac.* The head is covered by a large membranous hood, which represents exactly the circumference of the aperture of the shell, and arises from the expansion and coalescence of the cases of the uppermost pair of tentacles. The pediculated eye is partly covered by the over-hanging margin of the hood. Beside the 19 or 20 larger external tentacles, the mouth is surrounded by two pairs of flat, finger-shaped lappets, each of which encloses 12—16 smaller tentacles, but in other respects similar in structure to the larger. If a male specimen observed by me be not a monstrosity, then it may be concluded that in these organs a sexual difference is presented; (compare *Tijdsschrift voor de Wis-en Natuurk. Wetenschappen*, published by the *Koninkl. Nederl. Instituut*, I. 1848, blz. 67—73, Pl. I. figs. 1—3), *Trans.*

*of Zool. Soc.* IV. 1851, pp. 26, 27. [From letters of VAN DER HOEVEN, July and Sept. 1855, it appears that the above was no abnormity but the usual conformation of the males. "I have had the opportunity," he adds, "of examining recently two other male specimens, and hope to have time to publish this year or the following, some new observations on the structure.... The male differs from the female by the absence in the mantle of the lamellated glandular apparatus (OWEN'S *Mem.* p. 43, Pl. VIII. fig. 10), and by a different number of the digitations. (These are less numerous in the female.) A chief difference, however, is the presence of the great conoid body at the left side (see my *Contributions*, p. 27, Pl. 7, figs. 10, 11). This singular body has at the extremity and on the outside a large disc perforated by the orifices of numerous crypts. As the spermatophores (NEEDHAM'S *machines*) after their passage through the penis are inclosed in a bag formed of two coats, of a brown colour, and of nearly half an inch in diameter, I believe that the glandular apparatus may secrete this envelop, and that consequently it is a physiological analogon of the glandular apparatus described by OWEN in the mantle of the female. The fold connecting the labial processes at the inferior side above the funnel is in the male of a different conformation, (see *Contrib.* pp. 26, 27). The fine folds of the *external* labial processes are totally wanting, and instead of the so-called olfactory organ at the commissure of the *internal* labial processes, there is the cushion-like part (with 8—11 digitations), (*Contrib.* Pl. 8, fig. 9). As to the internal genital organs of the male, a large gland (*testis*), which in bulk surpasses all the other organs of the body, except the liver, is situated exactly where the ovary is in the female; another smaller, flat gland, more at the fore part, seems to secrete the *spermatophora;* a bag with an imperfect internal septum receives these *spermatophoræ* and brings them to the conical penis, which is situated not exactly, but nearly, as is the vulva (more in the mid-plane)."]

The genus *Nautilus* occurs also fossil in secondary and tertiary formations. It is the only genus still extant of a very numerous division of the Cephalopods, which lived in the seas of a former world and of which the remains are met with in mountain strata, especially in the older secondary formations. Here belong the *Ammonites*.

## Fossil genera related to *Nautilus*:

### *Clymenia* MUENSTER.

Comp. *Mém. sur les Clymènes et les Goniatites du calcaire de transition du Fichtelgebirge par le Compte* DE MUENSTER, *Ann. des Sc. nat.*, 2e Série, II. 1834, *Zool.* pp. 65—78, Pl. I.—L. VON BUCH *Ueber Goniatiten und Clymenien in Schlesien, Physikal. Abhandl. der Berl. Akad. der Wissench.* 1838 (section of genus *Nautilus* according to V. BUCH).

### *Lituites* BREYN, MONT.

Sp. *Lituites convolvans* SCHLOTH., BRONN *Lethæa geogn.* Tab. I. fig. 3.

### *Campylites* DESH., *Cyrtocera* GOLDFUSS.

*Orthoceratites* BREYN. Shell elongato-conical, straight, polythalamous, with septa perforated by siphon middle or subcentral. (Straight, not spiral *Nautili.*)

Sp. *Orthoceratites regularis* SCHLOTH., BRONN *Leth. geogn.* Tab. I. fig. 10, in *Thonschieferkalk (Wenlock shale?)*

Gen. *Actinoceras* BRONN does not, according to QUENSTEDT, differ from *Orthoceratites.*

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Appendix to the *Nautilacea.* Family of *Ammonitacea.* Shell polythalamous, with siphon external, marginal. Septa at the margin lobate, sinuate.

*Cornu Ammonis.* These petrifactions are of various, some of very remarkable, size. If the animal was placed, as we may conclude from analogy, within the shell as *Nautilus* is, the siphon would lie on the ventral side towards the margin of the funnel, and the expression *Sipho dorsalis,* used by Palæontologists, is consequently incorrect.—*Ammonites* are met with in great numbers, especially in the transition and older secondary formations. In the lowest chalk-strata they are still numerous, but afterwards decrease rapidly and after the chalk-periods are met with no more on our earth.

Compare G. DE HAAN *Specimen inaug. exhibens Monographiam Ammoniteorum et Goniatiteorum,* L. B. 1825, 8vo; L. DE BUCH *Note sur les Ammonites, Ann. des Sc. nat.* XVII. 1829, pp. 267—275; *Sur la distribution des Ammonites en familles, Ann. des Sc. nat.* XVIII. 1829, pp. 417—426; *Ueber Ammoniten, über ihre Sonderung in Familien,* &c., *Physik. Abhandl. der Berliner Akad. d. Wissensch., aus dem Jahre* 1830; *Ueber Ceratiten, ibid., a. d. J.* 1848; F. A. QUENSTEDT *Die Cephalopoden, Nebst einem Atlas von* 36 *Tafeln.* Tübingen, 1849, 8vo.

*Ammonites* BREYN. Shell spiral, discoïdal.

Sub-genera: *Goniatites* DE HAAN, *Ceratites* ejusd. and some others seem only to form sections, with species passing from one section into another.

Sp. *Ammonites nodosus* BRUG., *Ceratites nodosus* DE HAAN, BRONN *Leth. geogn.* Tab. XI. fig. 20; V. BUCH *Ueb. Ceratiten,* Tab. I. II. fig. 1, from the *Muschelkalk.* The species of the section of *Goniatites* are found in the transition formations.

*Scaphites* PARKINSON.

*Hamites* SOWERBY. Shell incurved at the apex, produced into a straight tube.

Sp. *Hamites rotundus* SOWERBY, BRONN *Leth. geogn.* Tab. XXXIII. fig. 9, from the chalk-formations.

*Turrulites* MONTF., LAM., *Turrites* DE HAAN.

*Baculites* LAM. Shell straight, conical.

Sp. *Baculites Faujasii* LAM., FAUJAS DE ST FOND *Hist. nat. de la mont de St Pierre*, Pl. 21, figs. 2, 3. QUENSTEDT unites with this *Baculites anceps* LAM. and *Baculites vertebralis* BRONN, *Leth. geogn.* Tab. XXXIII. fig. 6. These and *Baculites neocomiensis* D'ORB. are species from the chalk-formations, *Baculites acuarius* QUENSTEDT, Tab. 21, fig. 15, is hitherto the only known species from the *Jura*-formation.

B. *Dibranchiata.*

In this division of Cephalopods, to which most of the species now living belong, the funnel is closed below. There is an organ for the secretion of a black fluid, which the animal can eject through the funnel, the *ink-sac*. In the genus *Octopus* this ink-sac is enclosed within the liver, but in the rest is remote from it. The colouring matter of some species is used as a paint, *Sepia*. Since some observations have indicated the presence of an ink-sac in the fossil *Belemnites*[1], it may probably be concluded, with OWEN, that these petrifactions are internal shells of *Cephalopoda dibranchiata*, which conclusion has, in fact, been since established by the observation of petrified animals[2].

Family XIII. *Decacera* s. *Sepiacea.* Arms ten, two longer than the rest, round.

*Belemnites* BREYN, LAM. Shell fossil, conical, including internally a multilocular, shorter portion (*alveolites*).

*Belemnites* or *dart-stones;* thus named on account of their dart-like form. These petrifactions are found abundantly in the secondary mountains of the oolite and chalk-periods. Compare, amongst others, DUCROTAY DE BLAINVILLE *Mém. sur les Belemnites*, Paris, 1827, 4to; J. S. MILLER *Observations on Belemn., Transact. of the Geol. Soc. of London*, sec. Series, II. 1829, pp. 43—62, Pl. 6—9; BRONN *Leth. geogn.* pp. 402—418, pp. 714—720.

*Spirula* LAM. Animal with ten tentacles, two longer. Shell placed in the posterior part of animal, thin, spiral, with wreaths not contiguous. Partitions concave, perforated by siphon at the inside.

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[1] AGASSIZ in V. LEONHARD u. BRONN *Neues Jahrb. für Mineralogie, Geognosie u. Geol.* 1835, s. 163, BUCKLAND *Geology and Mineralogy*, London, 1836, 8vo, (*Bridgewater Treatises*, VI.) p. 374, Pl. 44', fig. 7, Pl. 44".

[2] *Lectures on the comp. Anat. and Physiol. of invertebrate Animals*, p. 337, 2nd ed. pp. 597—603.

Of this shell the animal is known from only imperfect figures, and some specimens not entirely perfect. See E. J. GRAY *Annals of Nat. Hist.* XV. pp. 257—260, Pl. XV. A mutilated specimen, investigated by OWEN in 1848, has afforded, however, by the anatomical particulars of internal structure the certainty that the animal resembles the *Sepiacea* or *Decacera*. There are two gills, two lateral or venous hearts, an ink-sac, a membranous tubular siphon, &c. See R. OWEN in *Zoology of the Voyage of H. M. S. Samarang, under the command of Capt. Sir* EDWARD BEECHER, *Mollusca*, Part I. London, 1848, pp. 6—17, Pl. IV.

Sp. *Spirula Peronii* LAM., *Nautilus spirula* L.; the shell has been several times figured, as in RUMPH. *Amb. Rariteitk.* Tab. 20, fig. 1, D'ARGENV. *Conchyl.* Pl. 5, fig. G, G, &c.

*Sepia* LAM. (species from genus *Sepia* L.). Body sacciform, depressed, margined on each side by a narrow membrane or longitudinal fin. A calcareous lamina elongate, dorsal, included in mantle.

*Seiche, Dintenfisch, Sea-cat, Ink-fish, Cuttle-fish.* The calcareous plate in the back consists of many laminæ. This part, known as *os Sepiæ* is used by miniature-painters for polishing ivory plates and forms a component of some tooth-powders.

Sp. *Sepia officinalis* L., BRANDT u. RATZEBURG *Mediz. Zool.* II. Tab. 31, fig. 1; GUÉRIN *Iconogr., Moll.* Pl. 1. fig. 4, &c. CARUS has given coloured figures from living animals, *Nov. Act. Acad. Cæs. L. C. Nat. Curios.* XII. 1824, pp. 313—322, Tab. 28—32.

*Sepioteuthis* BLAINV., *Chondrosepia* LEUCK.

*Loligo* LAM. Body elongate, pinnate posteriorly on each side. An elongate, narrow, horny, lamina at the back, covered by mantle.

Sp. *Loligo vulgaris, Sepia loligo* L., BLAINV. *Malacol.* Pl. 3, fig. 2, CARUS l. l. Tab. 29, fig. 1, &c.

*Ommastrephes* D'ORB., *Ommatostrephes* LOVÉN.

*Onychoteuthis* LICHTENST. The longer or all the arms armed with horny hooks.

*Onychoteuthis Fabricii* MOELLER, *Sepia loligo* FABR., *Fauna Groenl.*;—*Loligo Banksii, Loligo leptura, Loligo Smithii* LEACH in TUCKEY'S *Expedition to the River Zaire.*

*Sepiola* LEACH.

Sp. *Sepiola Rondeletii, Sepia sepiola* L., BLAINVILLE *Malacol.* Pl. II. fig. 3. Comp. R. E. GRANT on the anatomy of *Sepiola vulgaris* LEACH, &c. *Transact. of the Zool. Soc.* I. 1833, pp. 77—86, Pl. II.

*Rossia* OWEN.

*Loligopsis* LAM., *Perothis* ESCHSCHOLTZ, RATHKE.

LAMARCK has described this genus as having only eight arms; the long *tentacula* are often torn off. In common with *Cranchia* this genus has no membranous valve in the funnel. These animals are nearly transparent; the eight arms are short; the body is conical, posteriorly narrow and with two round fins at the extremity. Compare RATHKE *Perothis ein neues Genus der Cephalopoden, Mém. presentés à l'Acad. impér. des Sc. de St Petersbourg,* II. 1835, pp. 149—176.

*Cranchia* LEACH.

Sp. *Cranchia scabra* LEACH in TUCKEY'S *Exped. to the River Zaire,* p. 410. The fins are situated quite at the end of the body and the dorsal surface of the mantle is grown fast to the head.

Family XIV. *Octocera* s. *Octopoda.* Arms eight, large, often very long, surrounding the mouth in a circular row. Body sacciform, without fins. Funnel without valve.

*Argonauta* L. Arms furnished with a double row of acetabula (suckers), the two superior expanded into a membrane towards the extremity. Shell thin, involute, external, unilocular, with spire bicarinate.

This remarkable shelled animal excited long ago the admiration of the ancients; see PLINIUS *Hist. Nat.* IX. cap. 29. It was supposed that it made use of its fin-shaped arms as a sail, and thus in still weather could swim on the surface of the sea; but the observations of RANG (GUÉRIN *Magazin de Zool.* 1837[1]) have not confirmed this opinion; these arms lie expanded along the outside of the shell and serve to fasten the animal in its shell, which is not attached to it by any muscles. Many naturalists (RAFINESQUE, LEACH and others) thought, that this animal like the hermit-crab (*Pagurus*) lived parasitically in a borrowed shell, and that the shell of *Argonauta* belonged to some unknown species of mollusc. Accordingly this genus of *Octopoda* was named as a new genus *Ocythoë*. Although this animal can readily move from its shell, just like some *Pteropoda,* this opinion is now, however, sufficiently refuted. For the discrepant form of the male individuals which have no shell see above, p. 820—823.

On the anatomy of *Argonauta* compare POLI *Test. utr. Sicil.* Tom. III. and VAN BENEDEN *Nouv. Mém. de l'Académie royale des Sc. de Bruxelles,* Tom. XI. 1833.

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[1] POLI adopts this notion of the ancients, and he has even figured the animal in accordance with it (*Testac. utr. Sicil.* III. Tab. 40), but says that he has never himself seen the sails of the *Argonauta.*

Sp. *Argonauta Argo* L., Poli l. l. Tab. 40—43, Blainv. *Malac.* Pl. 1. fig. 1, Pl. 1. bis; Rang, Guérin *Magas. de Zool.* 1837, *Moll.* Pl. 86—88, from the Medit. Sea;—*Argonauta tuberculata* Lam., Rumph. *Amb. Rariteitk.* Tab. 18, figs. 1, 4, D'Argenv. *Conchyl.* Pl. 5, fig. c, from the Indian Ocean, &c.

*Note.*—Here would seem to be the place of *Bellerophon* Mont. fossil, from the oldest strata.

*Octopus* Lam. Body naked. Two horny lamellæ in the back, inclosed in mantle. (*Polypus* of the ancients.)

Amongst these naked eight-armed Cephalopods there were some species of which, as in the last, females alone were known, and of these it is that the *hectocotylus* of the male (now in some instances known) has been found attached in the sac of the mantle or in the funnel, as *Octopus granulosus* Lam. and *Tremoctopus violaceus* Delle Chiaje. See above, p. 820.

*Octopus* auct. With a double row of suckers in the arms.

Sp. *Octopus vulgaris, Sepia Octopus* L., Blainv. *Malacol.* Pl. 2, fig. 1, Cuv. *R. Ani., éd. ill., Moll.* Pl. 1.

*Tremoctopus* Delle Chiaje.

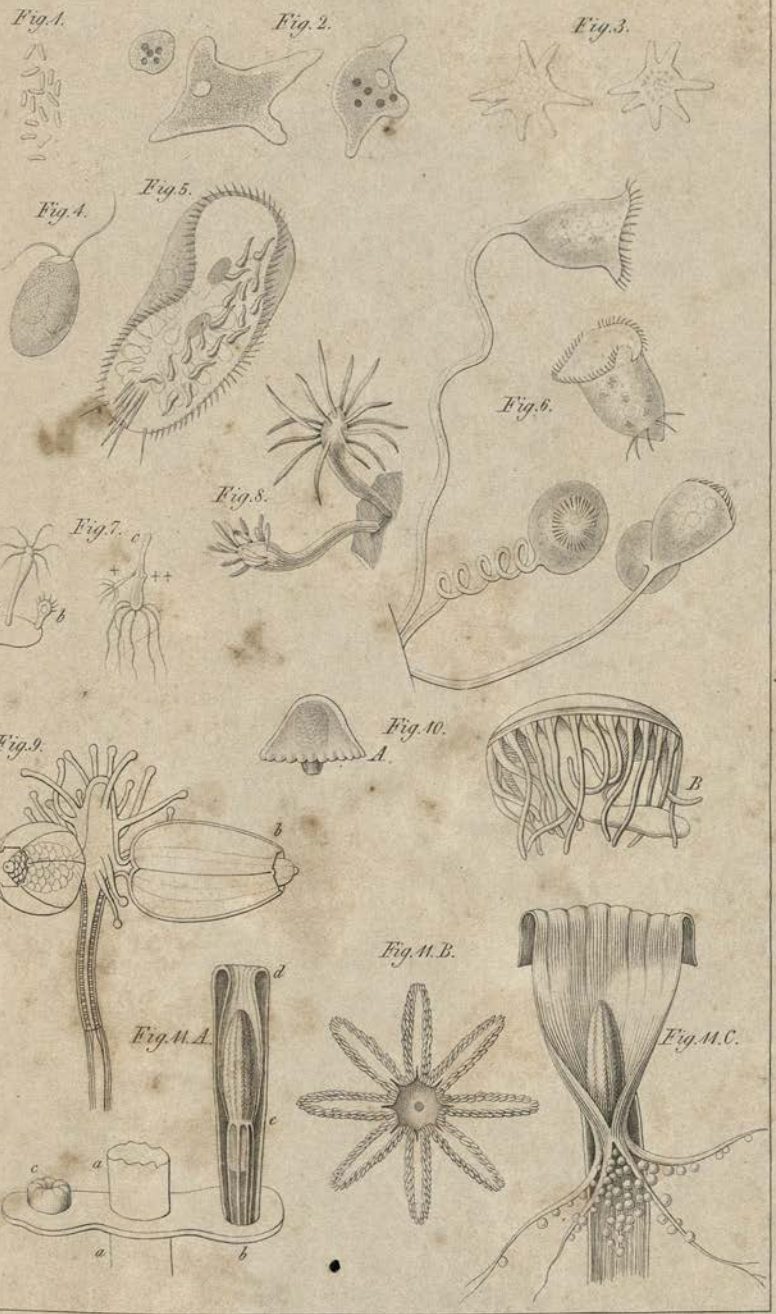
Sp. *Tremoctopus violaceus* Delle Chiaje, *Memorie,* Tab. 76, 1830.

*Eledone* Leach (ἐλεδώνη Aristot.). With a single row of acetabula in arms.

Sp. *Octopus moschatus* Lam., Blainv. *Malacol.* Pl. 2, fig. 2, Cuv. *R. Ani., éd. illustr., Moll.* Pl. 2, fig. 1.

*Cirroteuthis* Eschricht.

Sp. *Cirroteuthis Mulleri,* Eschricht *Nov. Act. Acad. Cæs. Carol. N. Cur.* xviii. 2, 1838, pp. 627—634, Tab. 46—48. A broad membrane connects the arms almost as far as the extremity. This species is a native of the coasts of Greenland.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H.Bruch sc.

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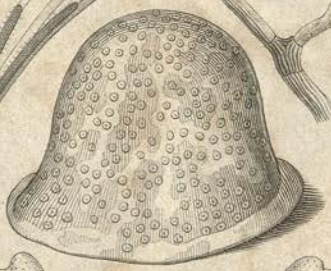
Fig. 6. A.



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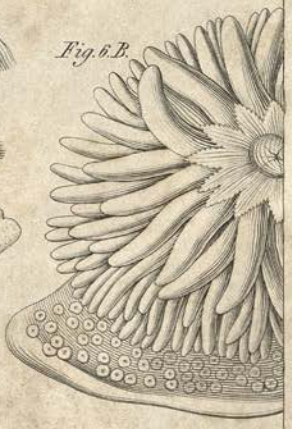
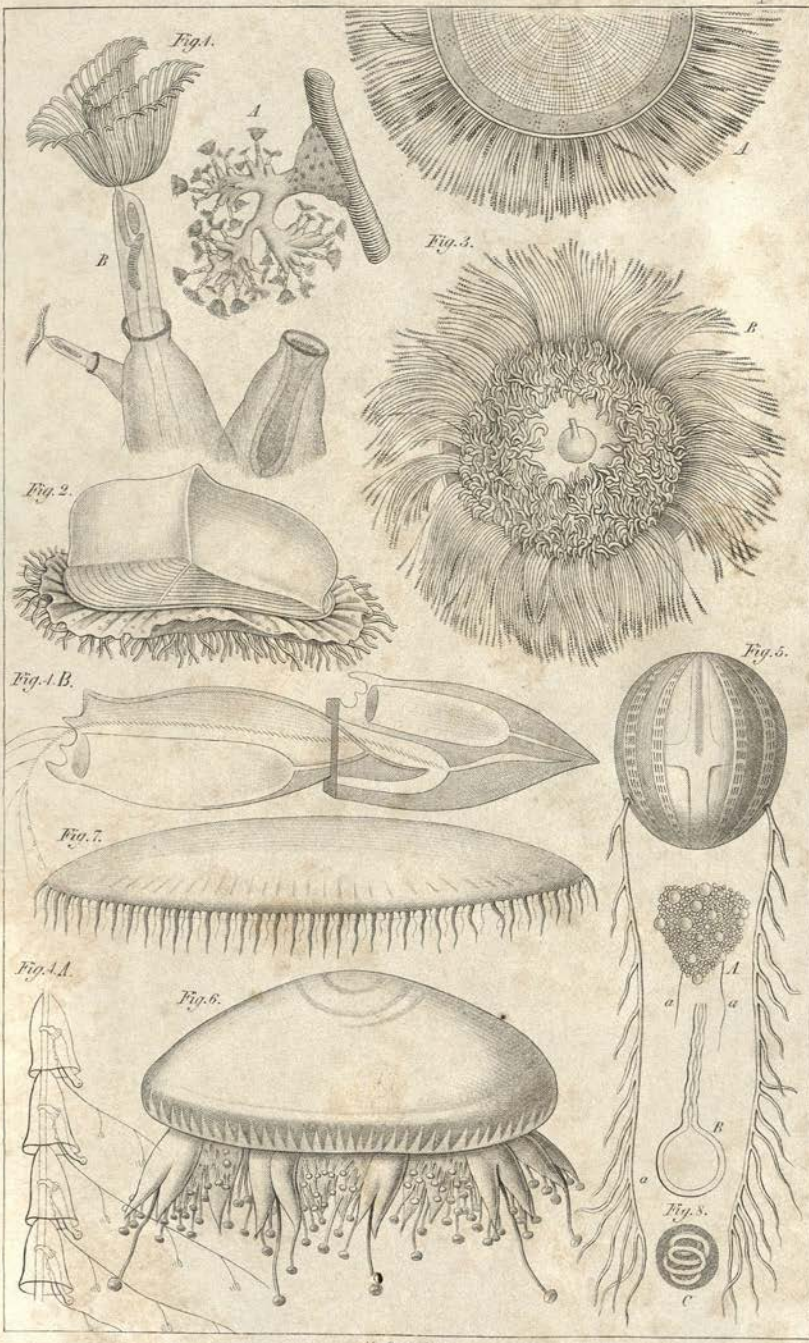


Fig. 7. B.

Fig. 7. A.

W. Bruch sc.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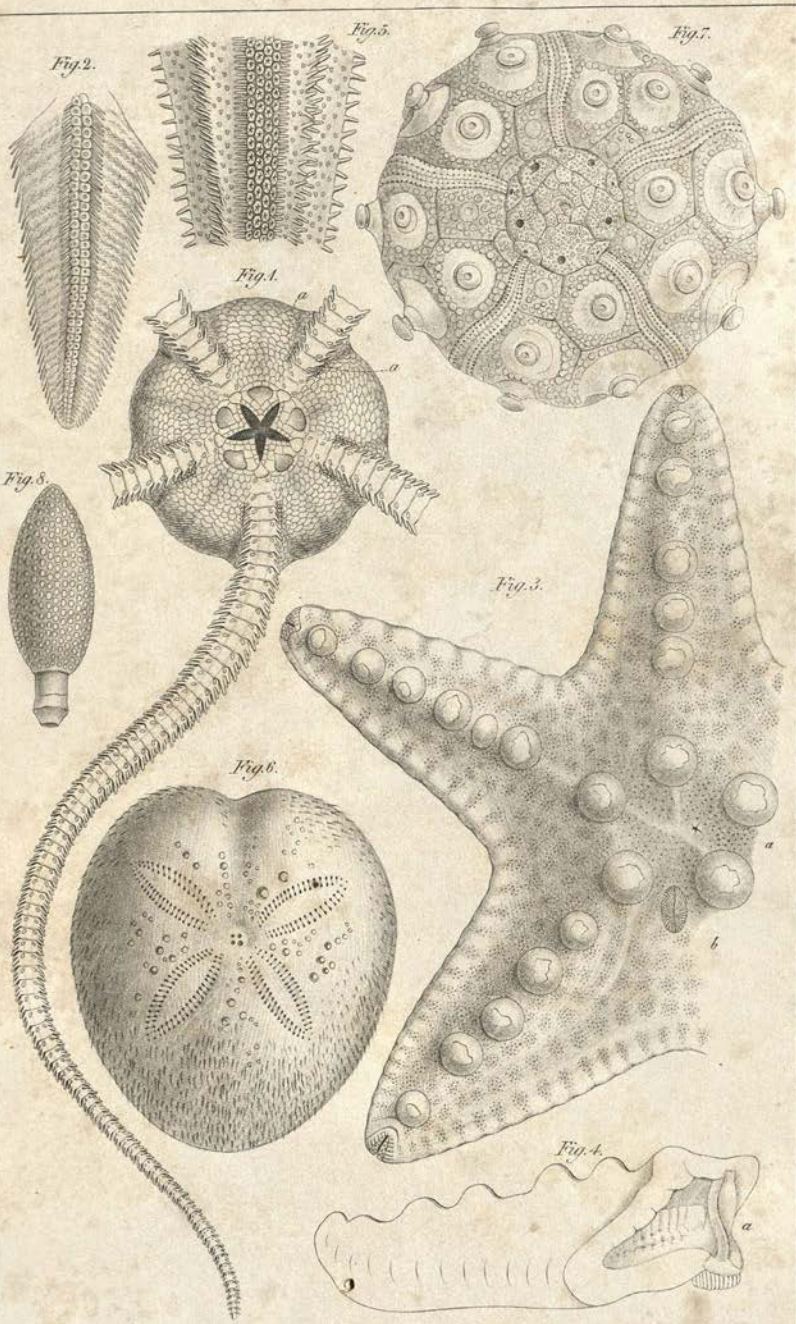


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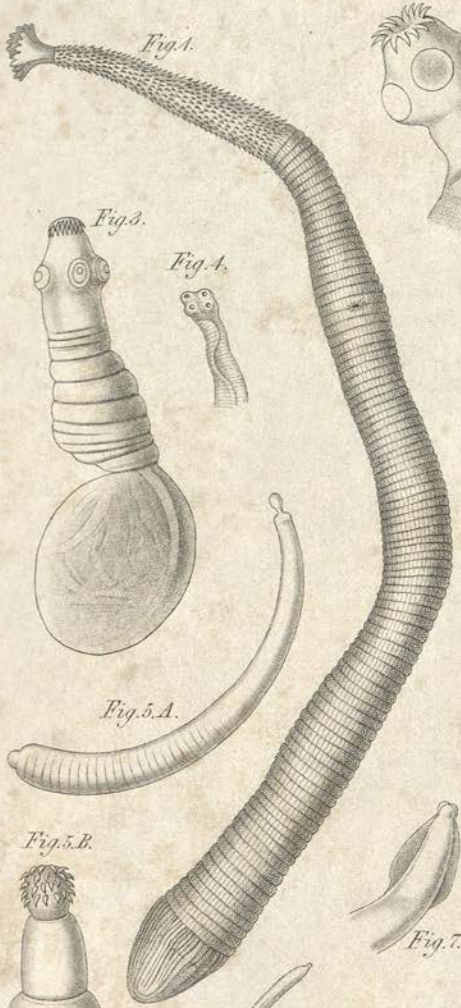
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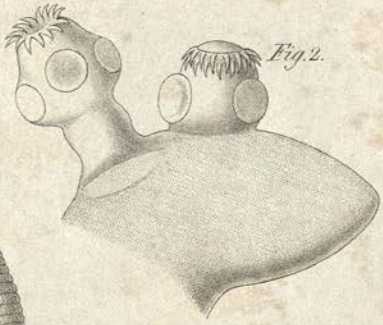
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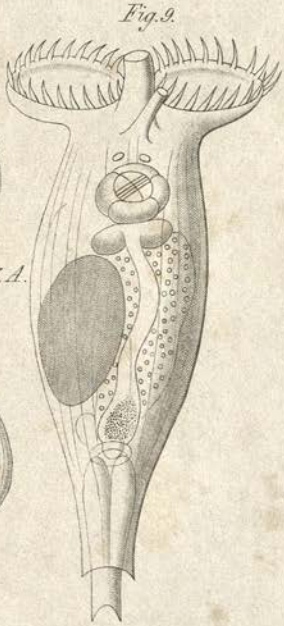
Fig.7.A.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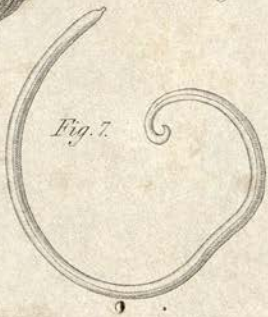
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Fig.7.B.

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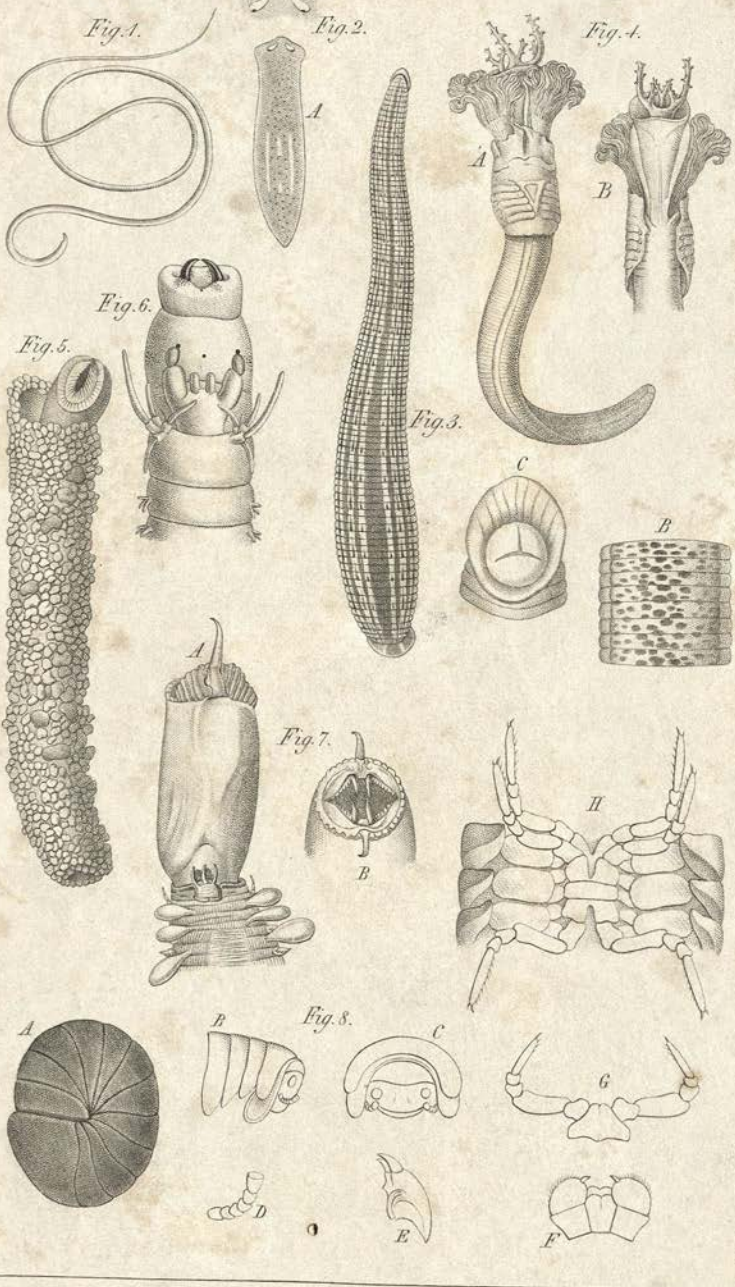


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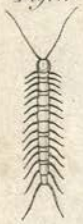

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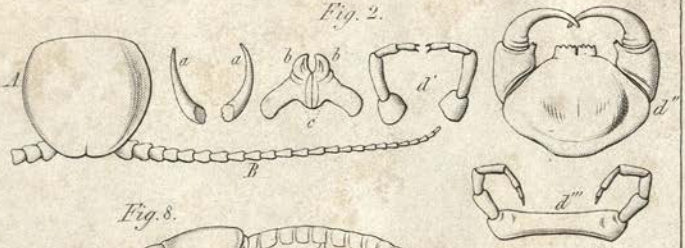


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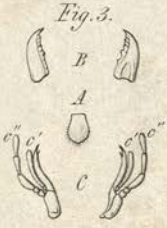


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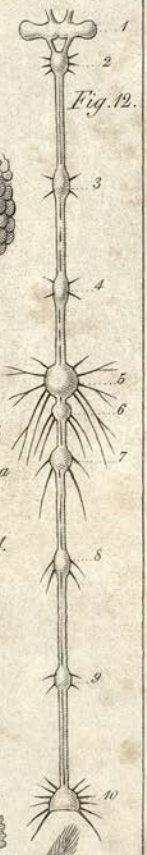


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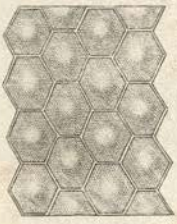

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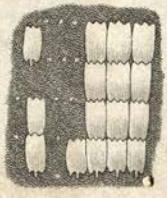

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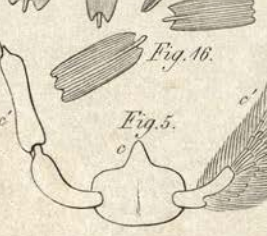

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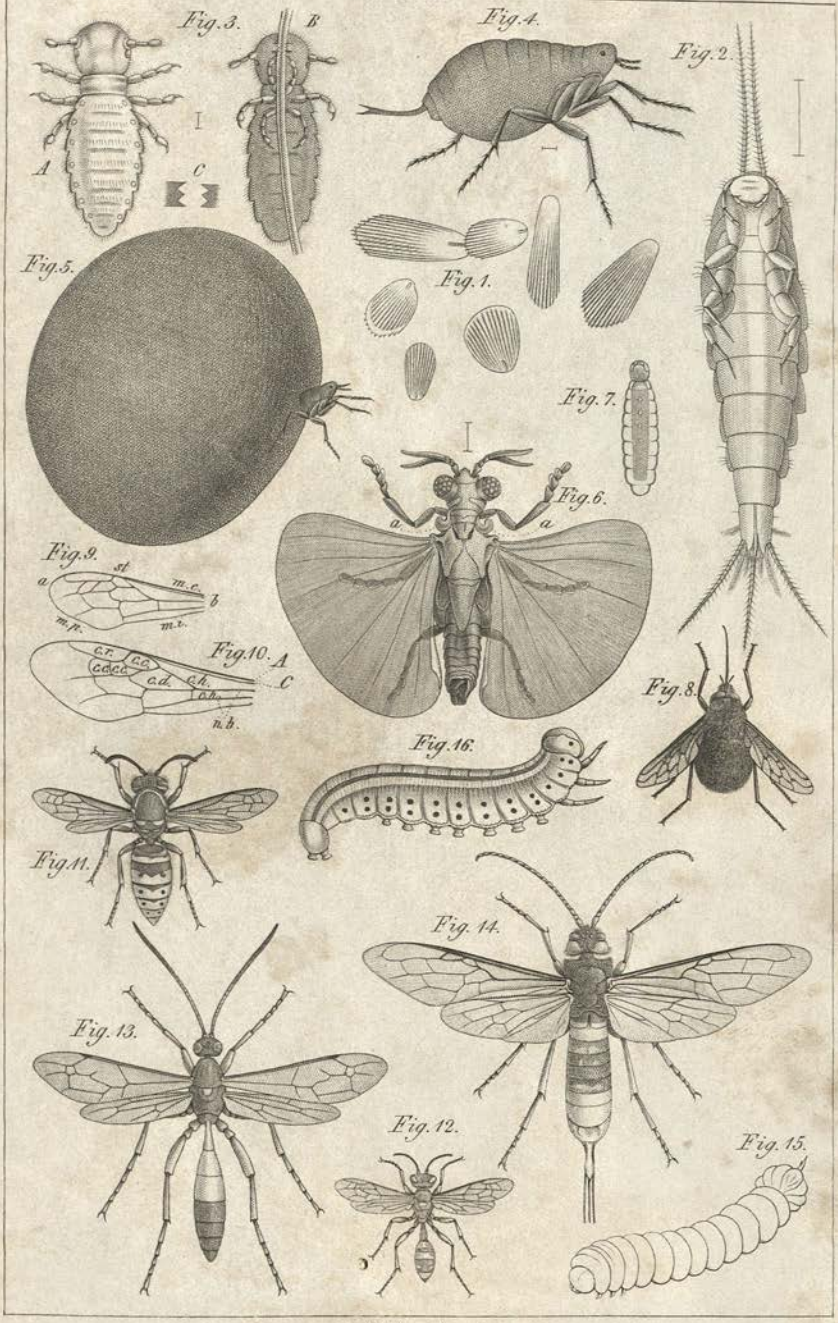
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m.c.
b
m.p.
m.i.
Fig. 10.
A
C
c.r.
c.c.
c.d.
c.h.
n.b.
Fig. 8.
Fig. 16.
Fig. 11.
Fig. 14.
Fig. 13.
Fig. 12.
Fig. 15.

H. Bruch sc.

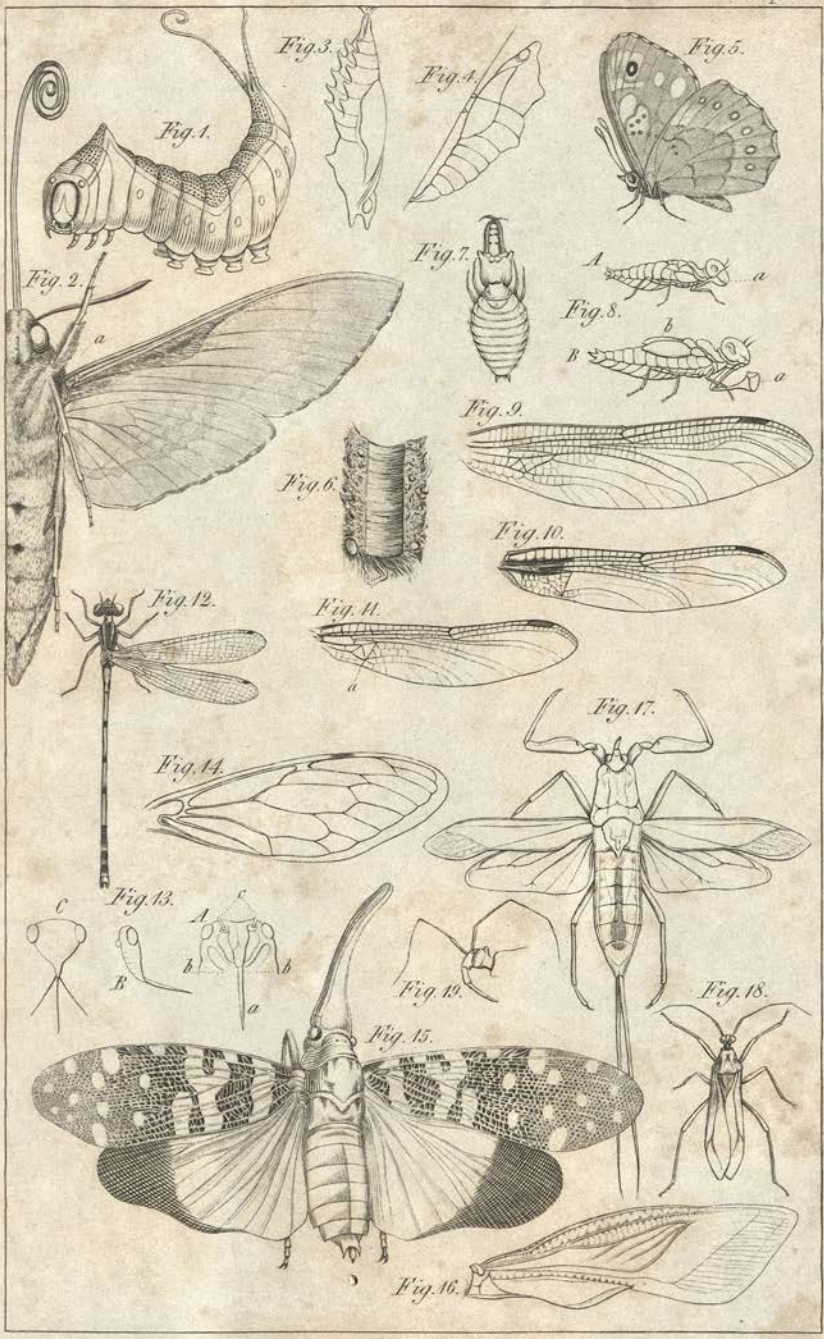
Fig.1.
Fig.2.
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Fig.3.
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Fig.14.
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Fig.18.
Fig.19.

H.Bruch sc.

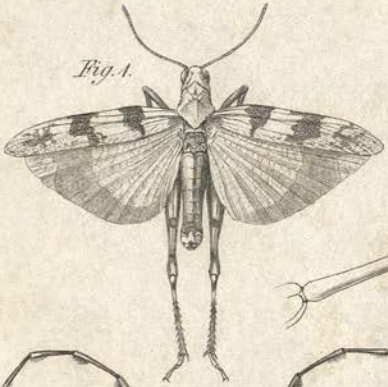


Fig.1.

Fig.5.

Fig.3.

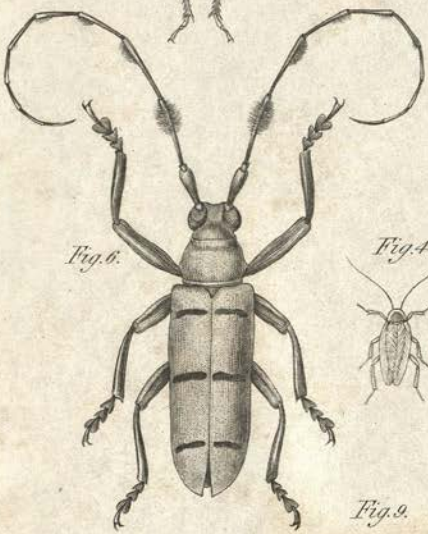


Fig.6.

Fig.2.

Fig.4.

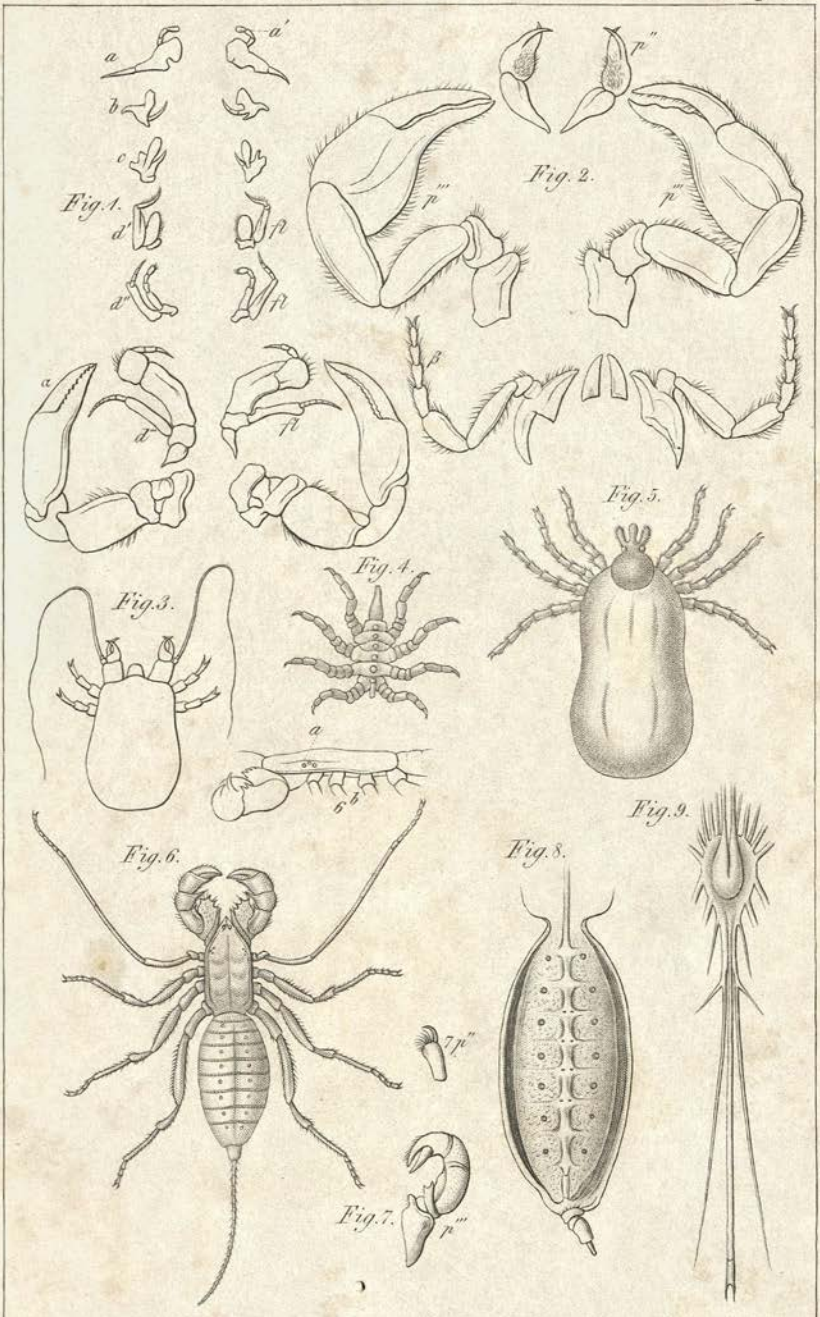
Fig.9.

Fig.7.

Fig.8.

Fig.10.

H.Bruch sc.




H. Bruch sc.

Fig.2.

Fig.1.

Fig.3.

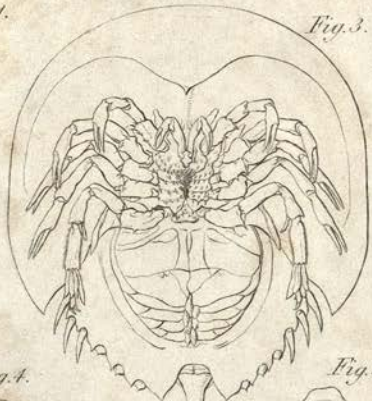


Fig.7.

Fig.4.

Fig.5.

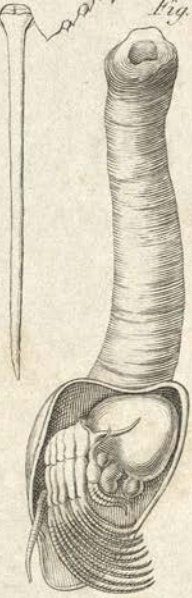


Fig.10.

Fig.6.

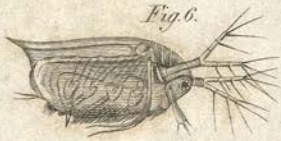


Fig.8.

Fig.9.

H.Bruch sc.

Fig. 1.

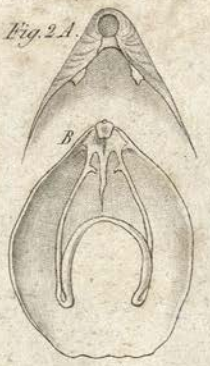


Fig. 2 A.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

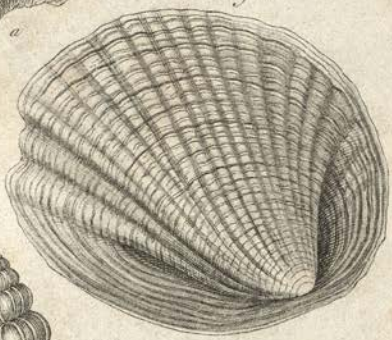


Fig. 8.

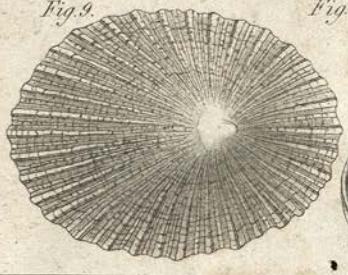


Fig. 9.

Fig. 10.

Fig. 11.

H. Bruch sc.

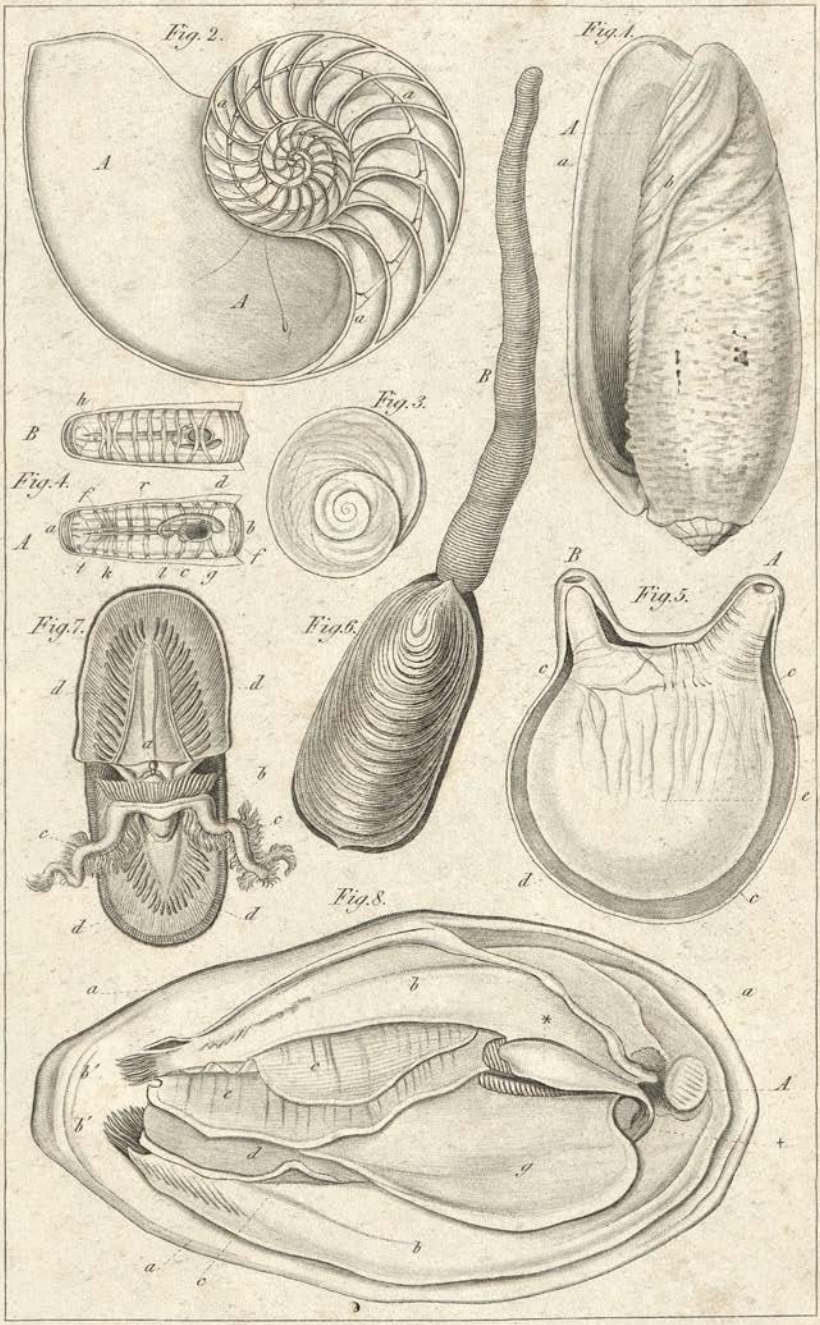


Fig. 2.
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H. Kruch sc.

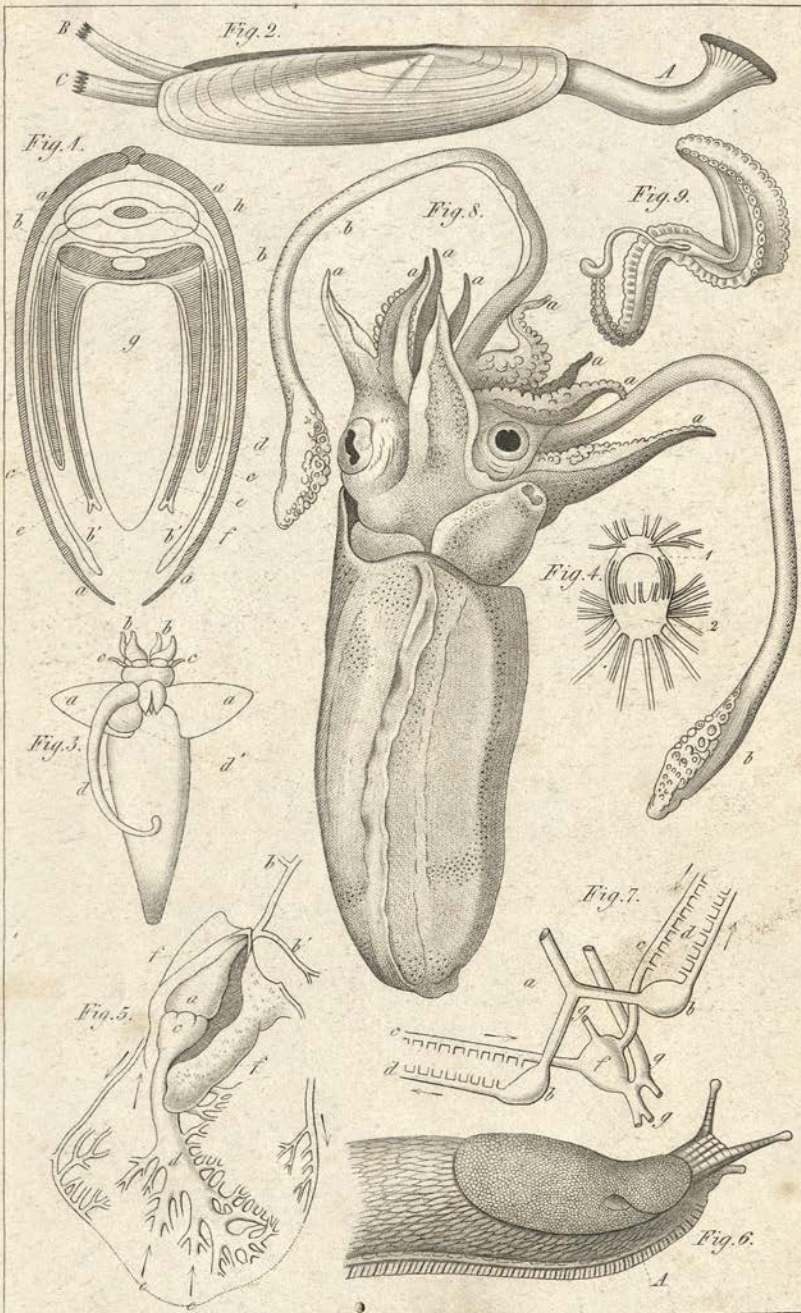
Fig. 2.
B
C
A
Fig. 1.
Fig. 8.
Fig. 9.
Fig. 4.
Fig. 3.
Fig. 5.
Fig. 7.
Fig. 6.
H. Frueh sc.

# EXPLANATION OF PLATES.

PLATE I. INFUSORIES, figs. 1—6; POLYPS, figs. 7—12.

Fig. 1. *Vibrio lineola*, p. 45, after EHRENBERG *Infusions-thierchen*, Tab. v. fig. 4, (very highly magnified, nat. size $\frac{1}{2000}$ line).

Fig. 2. *Amœba diffluens*, p. 46, after EHRENBERG, Tab. VIII. fig. 12, (magnified, nat. size $\frac{1}{24}$ line).

Fig. 3. *Siderolina calcitrapoïdes*, p. 49, magnified about 8 times, after a specimen from *Mont St Pierre*.

Fig. 4. *Chlamidomonas pulvisculus*, p. 51, after EHRENBERG, Tab. III. fig. X. B, (highly magnified, nat. size $\frac{1}{48}$ line).

Fig. 5. *Kerona mytilus*, p. 55, after EHRENBERG, Tab. XLI. fig. IX. (magnified, nat. size $\frac{1}{8}$ line).

Fig. 6. *Vorticella nebulifera*, p. 58, after EHRENBERG, Tab. XXV. fig. 1, (magnified, nat. size of the bell $\frac{1}{24}$ line).

Fig. 7. *Hydra grisea* L., p. 73, from nature, nat. size; *a*, a single polyp, extended; *b*, the like retracted; *c*, a polyp with two young buds †,††; the last still very incomplete.

Fig. 8. *Clava parasitica, Hydra multicornis*, p. 75, after FORSK. *Icon. rer. natur.* Tab. XXVI. fig. 6, B.

Fig. 9. *Coryne* GÆRTN., *Syncoryne ramosa* EHRENB. p. 75, highly magnified, after LOVÉN, WIEGM. *Archiv*, 1837, Tab. VI. fig. 19 *b*, *b* bell-shaped excrescences with eggs; comp. p. 70.

Fig. 10. *Campanularia* (*gelatinosa*), p. 76, in the embryonal state, magnified; B, in a more developed condition, in which it is about to quit the ovary; after VAN BENEDEN *Mém. de l'Acad. de Brux.* Tom. XVII. Pl. II. figs. 9, 18.

Fig. 11. A, B, C, *Tubipora musica* L., p. 82, after FREYCINET *Voyage de l'Uranie, Zool.* Pl. 88. A, development of a young polyp *c*; *a*, empty tube, free of its polyp; *b*, more developed polyp, opened longitudinally *d*, *e*; B, upper extremity of a polyp with the 8 tentacles and the mouth in the middle; C, longitudinal section of a tube; here the animal is seen, and below it the eggs within the tube, attached to long filaments.

## Plate II. Polyps.

Fig. 1. *Anthelia glauca*, p. 77.

Fig. 2. *Xenia umbellata*, p. 77, both after Savigny *Descript. de l'Egypte, Polypes*, Pl. I.

Fig. 3. *Corallium rubrum*, p. 83, magnified, after Milne Edwards, Cuvier *R. Ani., Zoophytes*, Pl. 80, fig. 1. *a*, *a*, *a*, three polyps, of which the two lowest are retracted within the bark; *b*, *b*, bark; *c*, stony axis.

Fig. 4. *Mopsea, Isis elongata*, Esper, p. 83, after a specimen in the National Museum of Nat. Hist. at Leyden.

Fig. 5. *Caryophyllia ramea* Lam., p. 86, after Milne Edwards, Cuvier *R. Ani., Zooph.*, Pl. 83, fig. 1.

Fig. 6. *Actinia coriacea* Cuv., p. 91, after Rapp *Polypen und Actinien*, Taf. I. 3, 4. A, in the contracted state; B, expanded.

Fig. 7. *Halodactylus diaphanus* Farre, p. 96. A, the gelatinous polypary of nat. size, after Van Beneden *Bryozoaires;* B, a polyp magnified 80 times, after Farre *Phil. Trans.* 1837, Pl. 26, fig. 7.

## Plate III. Polyps, fig. 1; Sea Nettles, figs. 2—8.

Fig. 1. *Plumatella cristata* Lam., p. 96, after Trembley *Polyp.* Pl. X. figs. 8, 9. Fig. A, natur. size; fig. B, three polyps magnified, of which one is retracted within its cell, and another still young and undeveloped.

Fig. 2. *Vettella scaphidia* Péron, p. 110, after Péron *Voyage aux terres Austr.* Pl. XXX. fig. 6.

Fig. 3. *Porpita umbella* Eschsch., p. 111, after Péron, Pl. XXXI. figs. 6 and 6 *a*; A, from the dorsal surface, B, from below.

Fig. 4. *Diphyes campanulifera* Eschsch., p. 118, after Quoy and Gaimard *Ann. des Sc. nat.* X. 1827, Pl. I. figs. 1, 3. A, the animal consisting of two pieces, nat. size B.

Fig. 5. *Cydippe pileus* Eschsch., p. 121, after Milne Edwards in Cuvier *R. Ani., Zooph.*, Pl. 56, fig. 2.

Fig. 6. *Cassiopea borbonica* Delle Chiaje, p. 123, after the figure of Delle Chiaje reduced in Guérin's *Iconographie.*

Fig. 7. *Æquorea violacea* Milne Edwards, p. 125, after the figure in the *Ann. des. Sc. nat.*, 2e Série, Tom. XVI. Pl. I. fig. 1.

Fig. 8. Nettle-organs (pp. 99, 100), from *Pelagia noctiluca* (p. 124), after Wagner *Icon. Zootom.* Tab. XXXIII. figs. X. XI. A, when slightly magnified the round vesicles amongst the pigment-

granules are seen; *a*, *a*, filaments. B, cell *a* more highly magnified, with the filament everted; C, filament lying in the cell rolled in a spiral.

PLATE IV. ECHINODERMS.

All the figures of this plate are taken from specimens in the *Rijks-Museum* of Nat. History at Leyden.

Fig. 1. *Ophiolepis imbricata* MÜELL. et TROSCH., p. 147, 1½ the nat. size, seen from the under surface. To save space, the basal pieces alone of four of the arms are delineated; *a*, *a*, fissures near the arms.

Fig. 2. Under surface of a ray from a Japanese species of *Astropecten*, p. 148, nat. size. Two rows of *tentacula* are seen here.

Fig. 3. *Oreaster hiulcus* MUELL. et TROSCH., p. 149, seen from above, of nat. size; the left side is in great part removed. *a*, anus; *b*, Madrepore-plate (*verruca dorsi*); compare p. 148.

Fig. 4. A ray of the same species opened. *a*, *Sand-canal* or *stone canal;* see p. 148.

Fig. 5. Under surface of part of a ray of *Asterias* (*Asteracanthion*) *rubens*, p. 149, nat. size. Four rows of tentacles are seen; see p. 149.

Fig. 6. *Spatangus purpureus*, p. 152, seen from above, reduced one half. There are four apertures of the genital organs (*ovaria* and *testes*) and four circumscribed *ambulacra*.

Fig. 7. *Cidaris imperialis* LAM., p. 156, after a specimen from the Red Sea. The spines have been removed in order that the form of the shell and the tubercles on which these spines are implanted might be shewn. There are *five* sexual apertures round the vent, on the same number of small pentangular plates of which the hindmost is the largest: between them are the five eye-plates. The *ambulacra* here run quite through. Compare pp. 150, 151.

Fig. 8. A spine of *Cidarites glandiferus*, or so-named *pierre judaïque*, fossil from the Jura formation.

PLATE V. Fig. 1, ECHINODERMS; figs. 2—7, INTESTINAL WORMS; figs. 8, 9, ROTIFERS.

Fig. 1. *Sipunculus nudus*, p. 160, after GRUBE in MUELLER'S *Archiv.*

Fig. 2. *Cœnurus cerebralis*, p. 182, after BREMSER *Icones helminth.* A part of the common bladder, with two worms highly magnified.

Fig. 3. *Cysticercus longicollis*, p. 182, magnified; after the same, *ibid.*

Fig. 4. *Tænia plicata*, pp. 180, 181, the head and anterior part of the body nat. size, after a specimen in the *Rijks-Museum*, Leyden.

Fig. 5. *Echinorhynchus gigas*, p. 184; A, nat. size, B, head of the same species magnified. After BREMSER *Icones helminthum.*

Fig. 6. *Tristoma granulatum*, p. 186, magnified two diameters; from a specimen in the *Rijks-Museum*, Leyden.

Fig. 7. *Ascaris leptoptera*, p. 190, nat. size. A, head, B, tail, both magnified; after BREMSER *Icones helminthum.*

Figs. 8 and 9, from EHRENBERG'S *Infusions-thierchen.* Fig. 8, *Furcularia gracilis*, p. 204; fig. 9, *Philodina megalotricha*, p. 205; both highly magnified.

## PLATE VI. RINGED WORMS, INSECTS.

With the exception of fig. 3 C, all the figures are from nature and of the natural size unless the contrary be expressed.

Fig. 1. *Gordius aquaticus*, p. 194.

Fig. 2. *Planaria torva*, p. 223, magnified two diam. B, head with two eyes.

Fig. 3. *Hirudo medicinalis*, p. 226. B, rings from the middle of the body on the ventral surface, magnified two diameters. C, the anterior part of the head, from the inferior surface with the margin that surrounds the mouth. Three fissures are seen from which the jaws proceed. This magnified figure is copied from that of BRANDT u. RATZEBURG *Mediz. Zool.* II. Taf. XXVIII. fig. 10.

Fig. 4. A, *Serpula bicornis* SAVIGNY, p. 236. B, the anterior part of the inferior surface shewing the *operculum.*

Fig. 5. *Hermella*, p. 236. A new species from the Cape of Good Hope.

Fig. 6. *Lycoris*, p. 241. The anterior part with *proboscis* exserted. A new species from the Cape of Good Hope.

Fig. 7. *Polyodontes maxillosa*, p. 245. A, the anterior portion with the *proboscis* exserted, B, the *proboscis* on the inferior surface with the four jaws.

Fig. 8. *Glomeris ovalis, Sphæropœus insignis* BRANDT, p. 292. A, the animal rolled together. B, the head and anterior rings from the side, and C, from before; D, antenna; G, first pair of feet; H, two rings from the middle of the body with four pairs of feet. (D—H magnified).

## PLATE VII. INSECTS.

With the exception of figs. 4 and 5, all the figures are from nature.

Fig. 1. *Lithobius forficatus*, p. 294. Natural size.

Fig. 2. Oral organs, head and antennæ of a large *Scolopendra*, slightly magnified. A, head; B, antenna; *a a*, upper jaws; *b b*, under jaws; *c*, under lip; *d'*, first; *d''*, second; *d'''*, third pair of feet.

Fig. 3. Oral organs of *Gryllotalpa vulgaris*, magnified, illustrating p. 249. A, upper lip; B, upper jaws; C, under jaws; *c' c'*, palps; *c'' c''*, *galea* or helm of the lower jaws (internal palps); D, under lip with its palps *d d*.

Figs. 4, 5. Head, spiral tongue and other oral organs of *Noctua pœa*, magnified; after SAVIGNY *Mémoires*, I. Pl. III. fig. 1. Compare p. 250.

Fig. 4. A, basal piece of antenna, *a a*, compound eyes; *b b*, upper jaws; *c'*, under jaws (spiral tongue); *d' d'*, attachment of the palps of the under lip that have been removed.

Fig. 5. The under lip *c*, with its palps *c' c'*, divested on the left side of the hairs with which they are beset.

Fig. 6. Intestinal canal of *Gryllotalpa vulgaris*, natural size, to illustrate pp. 253—256; *a*, œsophagus; *b*, crop or *proventriculus*; *c*, muscular stomach, with two blind appendages near its inferior orifice; *d*, *e*, stomach, or duodenum, according to M. DE SERRES; *g*, *h*, intestinal canal, slightly unrolled, as in *e*; *f*, the short and numerous urinary vessels, which terminate by a common efferent duct at *g*.

Fig. 7. The two secretory tubes of the web in *Cossus ligniperda*, natural size, see p. 392.

Fig. 8. A *Gryllotalpa vulgaris* not yet full grown, shewing the air-slits (*stigmata*) 1—10, see p. 261. This figure may serve at the same time as an example of imperfect metamorphosis, see p. 273.

Fig. 9. A portion of a stem of the air-tubes with three branches from a large *Scolopendra*, see p. 259.

Fig. 10. Internal sexual organs of male *Gryllotalpa vulgaris*, magnified two diameters, to illustrate pp. 267—269; *a a*, *testes*; *b b*, efferent vessels; *c c*, *prostate* (blind tubes, pp. 268, 269); *c'*, such a tube unrolled; *d*, base of *penis*, covered on the upper surface with small blind vascules like *villi* (COWPER'S glands?).

Fig. 11. Internal sexual organs of female of the same species; *a a*, ovaries; *b b*, oviducts; *c*, blind sac (*receptaculum seminis*), of which the very fine duct *c'* terminates in the *vagina*. See pp. 265, 266.

Fig. 12. Nervous system of *Gryllotalpa vulgaris* magnified two diameters, see p. 276; 1, first nerve-ganglion with the optic nerves and those of the antennæ, behind it a ring, through which the œsophagus passes; 2—10, the succeeding nerve-ganglia.

Fig. 13. Head and first piece of thorax (*prothorax, corselet*) of *Gryllotalpa vulgaris* seen from above, slightly magnified; A, A, compound eyes; *a, a,* simple eyes, *ocelli* or *stemmata.* See p. 249.

Fig. 14. A small piece of the *cornea* of a compound eye from *Sphinx atropos,* with the hexangular *facettes,* magnified 200 diameters; see p. 279.

Fig. 15. A piece of the under surface of an upper wing from *Nymphalis urticæ,* p. 411, magnified more than 40 diameters, and drawn by means of incident light. The surface divested of scales then appears black; the places for the attachment of the scales are seen as white points. Comp. p. 390.

Fig. 16. Scales from the upper surface of the upper wing of the same insect, magnified about 75 diameters, and drawn by means of transmitted light under a microscope of OBERHAUSER, p. 390.

## PLATE VIII. INSECTS.

Fig. 1. Scales of *Machilis maritima,* p. 297, seen under the microscope.

Fig. 2. *Lepisma saccharina* (p. 298); magnified and seen on the under surface, after G. R. TREVIRANUS *Verm. Schr.* II. Tab. II. fig. 1.

Fig. 3. *Trichodectes Equi* magnified, as an example of *Mallophaga,* pp. 301, 302, after GURLT *Magaz. f. d. gesammt. Thierheilk.* IX. Tab. I. figs. 4—6. A, from above; B, from below, attached to a hair; C, the jaws; the absolute size is indicated by a line, as is also done in figs. 2 and 4.

Fig. 4. *Pulex penetrans,* male, (p. 305).

Fig. 5. The pregnant female. Both this figure and the preceding after DUMÉRIL *Cons. gén. s. l. Ins.* Pl. 53, figs. 4, 5.

Fig. 6. *Xenos Peckii,* female, (p. 307), after KIRBY *Linn. Transact.* XI., magnified; *a, a,* the shield-covers (*elytra*).

Fig. 7. *Xenos Rossii,* female, magnified, after V. SIEBOLD.

Fig. 8. *Bombylius discolor,* p. 334.

Figs. 9, 10. Upper wings of *Hymenoptera,* fig. 9 of *Apis mellifica,* fig. 10 of *Bombus;* pp. 347, 348; *m, e,* outer margin (*margo exterior*); *a,* apex; *b,* base; *m, p,* posterior margin; *m, i,* internal margin; *s, t, stigma;* A, *radius;* C, *cubitus; c, r, cellula radialis; c,c, c,c, c,c, cellulæ cubitales; c, d, cellula discoïdalis; c,h, c,h, cellulæ humerales; n, b, nervi brachiales.*

Fig. 11. *Vespa vulgaris*, p. 362.
Fig. 12. *Mellinus arvensis*, p. 367.
Fig. 13. *Trogus lutorius*, p. 381.
Fig. 14. *Sirex gigas*, female, p. 386.
Fig. 15. The larva of this insect, after RŒSEL.
Fig. 16. The larva of *Cimbex variabilis*, p. 389, after RŒSEL.

## PLATE IX. INSECTS.

Fig. 1. Caterpillar of *Cerura vinula*, p. 403, after RŒSEL.
Fig. 2. *Sphinx convolvuli*, p. 406, seen from below. At *a*, the wing-hooklet, *retinaculum*, is seen, p. 393.
Figs. 3, 4. Pupæ of butterflies. Fig. 3, a pupa hanging free, as in the *Tetrapoda*, p. 410; fig. 4, a pupa fastened by a transverse thread, as in the *Hexapoda*, p. 409.
Fig. 5. *Satyrus Ægeria*, p. 410.
Fig. 6. Case of a larva of *Phryganea*, p. 414, opened to shew the smooth internal surface.
Fig. 7. Larva of the Ant-Lion, *Myrmeleon formicarium*, p. 419.
Fig. 8. A, larva; B, pupa of a *Libellula*, pp. 420, 421, after LYONET: *a*, mask-like under lip; *b*, rudiments of the wings.
Figs. 9—11. Left upper wing of *Libellæ*, p. 421; fig. 9, *Æshna grandis*, fig. 10, *Libellula depressa*, fig. 11, *Æshna forcipata*; *a*, triangular wing-cell.
Fig. 12. *Agrion puella* or *furcatum* CHARP., p. 422.
Fig. 13. Head of a *Cicada* as an example of the beak (*rostrum*) of the *Homoptera* (p. 430); A, seen from below; B, from the side; C, in front; *a*, in fig. A, the sucker; *b*, *b*, the insertion of the first pair of feet; *c*, the antennæ. In fig. C, the three filaments which are enclosed in the sheath of the sucker, are represented after the sheath has been removed.
Fig. 14. Anterior or upper wing of a *Cicada*; this wing is entirely membranous. Comp. fig. 16.
Fig. 15. *Fulgora*, p. 437; *Fulgora maculata* OLIV. East Ind., nat size.
Fig. 16. Fore-wing of *Belostoma indicum*, (p. 441), to illustrate the characters of the *Hemiptera heteroptera*, p. 439.
Fig. 17. *Nepa*, p. 441; *Nepa rubra* from Java, much resembling *Nepa cinerea*, but larger.
Fig. 18. *Reduvius personatus*, p. 444. It is the specimen to which I referred in the note in p. 276, and which is distinguished by the shortness of one of the feet, (the second on the left side).

Fig. 19. Head of a *Reduvius* from the side, as an example of the sucker (*rostrum frontale*) in the *Heteroptera*; see p. 439.

## Plate X. Insects.

Fig. 1. *Gryllus cœrulescens*, p. 453.

Fig. 2. *Phyllium siccifolium*, p. 460, a female, the figure somewhat diminished.

Fig. 3. Head of a species of *Empusa*, to exhibit the pectinate antennæ, the character of the males, p. 461.

Fig. 4. *Blatta lapponica*, p. 462.

Fig. 5. *Eumorphus marginatus*, p. 469.

Fig. 6. *Adesmus Wallichii* Hope, from Java, as an example of *Cerambycina*, *Lamia*, p. 478.

Fig. 7. *Entimus scapulosus* Chevrolat, as an example of the *Curculionita*. This species belongs to the same sub-genus as *Curculio imperialis*, p. 487.

Fig. 8. *Lytta vesicatoria*, the Spanish fly, p. 500.

Fig. 9. *Melolontha vulgaris*, p. 514.

Fig. 10. Under jaw of a *Carabus* magnified, to illustrate the primary characteristic of the *Carabicina*, namely the two palps, see p. 545.

## Plate XI. Arachnids and Crustaceans.

Fig. 1. Oral organs and shears (first pair of unchanged feet) of *Portunus mœnas*, p. 679. See p. 600; *a*, upper jaws; *a'*, palps; *b*, first pair of under jaws; *c*, second pair of under jaws; *d'*, first; *d''*, second; *d'''*, third pair of foot-jaws; *fl. flagrum*, or the palp attached to these jaws; *α*, first pair of unchanged feet, the shears or claws.

Fig. 2. Oral organs and first pair of feet of *Scorpio reticulatus*, natural size. According to the theory of Savigny (p. 557), the upper jaws *p''* correspond to the second pair of foot-jaws of the decapod crustaceans; the under jaws *p'''* to the third pair of these foot-jaws; the first pair of feet, *β*, correspond to the second pair of feet of the *decapoda*. Between these feet two triangular plates are seen; see the note, p. 557.

Fig. 3. *Nymphon grossipes* (p. 573) in its first state, magnified (natural size about $\frac{1}{4}$ line); after Kroeyer's *Tidsskr.* III. Pl. 3, fig. 26; fig. 4; comp. p. 571.

Fig. 4. *Pycnogonum littorale*, p. 573, after Guérin *Iconogr., Arachn.* Pl. 4, fig. 1, nat. size.

Fig. 5. *Ixodes Ricinus*, p. 577, magnified after GURLT *Magazin f. d. gesammt. Thierheilk.* IX. Tab. I. fig. 18.

Fig. 6. *Telyphonus proscorpio* LATR., p. 586, nat. size. Fig. 6 *b*, the cephalothorax from the side, to shew the lateral eyes *a*.

Fig. 7. *p''*, *p'''*, oral organs of the same arachnid; *p''*, upper jaws; *p'''*, under jaws; magnified two diameters.

Fig. 8. Dorsal vessel or heart of *Telyphonus*, with the adipose body, magnified.

Fig. 9. Nervous system of *Telyphonus*, magnified.

## PLATE XII. ARACHNIDS AND CRUSTACEANS.

Fig. 1. An upper-jaw of *Epeira diadema* laid open, with the salivary duct, magnified, from TREVIRANUS *Ueb. den innern Bau der Arachniden*, Tab. II. fig. 21, see p. 560.

Fig. 2. Spinnarets of *Aranea atrox* (see p. 588), magnified, after TREVIRANUS *op. cit.* Tab. V. fig. 43; *a*, vent; *b*, *b*, larger and anterior; *c*, *c*, smaller posterior; *d*, *d*, lateral posterior papillæ, accessory feelers according to TREVIRANUS (*palpi accessorii*).

Fig. 3. *Limulus moluccanus*, p. 623, reduced. A female seen on the under surface.

Fig. 4. *Argulus foliaceus*, p. 631, on the under surface, laying its eggs; after JURINE *Ann. du Mus.* VII. Pl. XXVI. fig. 3.

Fig. 5. *Anatifa lævis*, p. 638; one side of the shell is removed to exhibit the animal in its natural position; nat. size.

Fig. 6. *Daphnia pulex*, p. 641, a male, magnified after STRAUS *Mém. du Mus.* V. Pl. XLIX. fig. 18.

Fig. 7. *Idotea entomon*, p. 654, nat. size.

Figs. 8—10. *Portunus Mœnas*, p. 679, nat. size; fig. 8, from above, fig. 9, under surface with the tail lying on it, fig. 10, the tail thrown back.

## PLATE XIII. MOLLUSCS.

Fig. 1. *Chiton Cummingii.* Example of a multivalve shell, p. 682; comp. p. 789.

Figs. 2—7. Examples of bivalves, p. 682.

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Fig. 3. Shell of *Avicula* (*Meleagrina*) *margaritifera*, pp. 730, 731. On the inside are seen some pearls attached. *a*, impression of the adductor muscle.

Fig. 4. *Arca tortuosa* L., p. 733.

Fig. 5. Shell of *Trigonia pectinata* LAM., p. 734. From the inside, to shew the hinge (*cardo*).

Fig. 6. *Venus Dione* L., *Cytherea Dione* LAM., p. 742. The shell is placed in the position according to which LINNÆUS has described it (see the note, p. 683), namely, with the point, A, downwards; the *fissura*, *b*, forwards; the *lunula*, *a*, backwards.

Fig. 7. *Venus* (*Cytherea*) *erycina* LAM. Right valve from within. A, the point; *a*, lunular cavity; *b*, fissure; *c*, hinge; *d*, impression of the anterior; *e*, of the posterior adductor muscle; *f*, impression of the mantle; *g*, *g*, inferior margin of the shell. In this figure the shell is placed in its natural position. On the left side the fore end is placed, which the animal, when moving, directs forwards.

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## PLATE XIV. MOLLUSCS.

Fig. 1. Shell of *Oliva erythrostoma* LAM., p. 810; example of an involute shell, p. 683. A, the aperture; *a*, external margin; *b*, internal margin.

Fig. 2. Shell of *Nautilus Pompilius* L., divided in the midplane, p. 825, an example of a shell rolled upon itself, and at the same time many-chambered (*cochlea revoluta*, *polythalamia*) pp. 683, 684; A, A, the last chamber, or cavity, in which the animal lies; *a*, *a*, *a*, the siphon which traverses the successive chambers.

Fig. 3. A cover (*Operculum*) of *Turbo*, from the inside; see p. 684.

Fig. 4. *Salpa* (*runcinata?*) p. 699. Of the natural size, from a specimen presented to me by Prof. V. BENEDEN. A, the animal seen from the surface which is commonly turned upwards, according to ESCHRICHT the ventral surface. Here the muscular belts extend throughout; B, the animal seen from the opposite side, where the muscular belts are interrupted; *a*, (in fig. A) the fissured aperture which the animal turns forwards; *b*, the posterior aperture; *c*, the so-named nucleus, or the collection of the viscera; *d*, the *salpa* chain in process of development; *f*, *g*, muscular

belts; *k*, the gill; *l*, the heart; *r*, dorsal folds (*endostyle?*); *t*, languet; *b*, (in B) the cerebral ganglion.

Fig. 5. *Ascidia* (*Cynthia*) *Momus*, p. 707; after SAVIGNY *Mémoires*, II. Pl. VI. fig. 1. A, respiratory aperture; B, cloacal aperture; *c*, *c*, *c*, outer covering, of which one half is removed in order to shew the internal envelop *d* (the mantle); *e*, muscular fibres on the mantle.

Figs. 6, 7. Fig. 6. *Lingula anatina* LAM., p. 721; after CUVIER *Ann. du Mus.* I. fig. 6. The animal in its shell with the peduncle B.

Fig. 7. The animal removed from the shell, one of the laminæ of the mantle thrown upwards; *a*, the cerebral ganglion, according to CUVIER; *b*, mouth; *c*, *c*, the two arms; *d*, *d*, *d*, *d*, pectinated gill-folds on the mantle.

Fig. 8. The animal of an *Anodonta* in the shell, of which the right valve is removed, as an example of *Lamellibranchiates*, pp. 723, 724; comp. Pl. 15, fig. 1; *a*, shell (left valve from the inside); *b*, *b*, the two laminæ of the mantle; *c*, *c*, outermost gills; *d*, *e*, inner gills; *g*, the flat ventral disc projecting between the gills; * tentacles round the mouth, those of the right side alone are seen; † mouth; A, anterior adductor muscle; *b'*, *b'*, the posterior border of the mantle beset with fringe-like appendages.

## PLATE XV. MOLLUSCS.

Fig. 1. A transverse section of *Anodonta anatina*, schematic after NEUWYLER, *Neue Denkschr. der allg. Schweizer. Gesellsch. für die gesammten Naturwissenschaften*, Bd. VI. 1842, Tab. 1; *a*, *a*, *b*, *b*, and *g*, as in fig. 8 of the preceding plate; *c*, external laminæ of the outer gills with the dorsal side attached to the mantle; *d*, internal lamina of the outer gill; *e*, external; *f*, internal lamina of the inner gill; *h*, heart, traversed in the middle by the rectum.

Fig. 2. *Solen legumen* L., p. 754; after POLI *Test. utr. Sicil.* I. Tab. XI. fig. 15; A, the foot projecting at the anterior extremity of the shell; B, C, the two tubes (tracheæ) coming into view from the shell behind.

Fig. 3. *Clio borealis* GMEL., p. 775; after ESCHRICHT *Anat. Unters.* Tab. I. fig. 3; the animal is represented from the ventral surface; *a*, *a*, fin-like appendages; *b*, *b*, conical appendages; *c*, *c*, tentacles of the head; *d*, everted penis with a vesicle *d'* at the base.

Fig. 4. The central nervous system of *Helix Pomatia* L.; after BRANDT and RATZEBURG *Medic. Zool.* II. Tab. 34, fig. 12; compare p. 766; 1, ganglion situated above the œsophagus; 2, below it.

Fig. 5. Blood-circulation of *Helix Pomatia* L.; after CUVIER, as an example of the *Pneumonica*, p. 811; *a*, heart; *c*, auricle, both lie in the pericardial sac, laid open; *b*, *b'*, arteries; *e*, *e*, venous currents, from which the pulmonary veins in the respiratory cavity arise, which pass into the trunk *d* that runs to the auricle; *f*, *f*, calcareous sac or kidney which surrounds the pericardium. Compare pp. 760, 761.

Fig. 6. *Limax ater* L., the anterior portion of the animal, after BRANDT u. RATZEB. *op. cit.* Tab. 38, fig. 3, (*Arion empiricorum brunneus*). A, respiratory aperture at the margin of the mantle. See p. 817.

Fig. 7. Circulation of the blood in a cephaloped mollusc, *Loligo*, after CUVIER *Tabl. élém. de l'Hist. nat. des Animaux*; *a*, vena cava, which divides into two branches; *b*, *b*, lateral or venous hearts; *c*, *c*, branchial veins; *d*, *d*, space where the gills are situated; *f*, the middle or arterial heart; *g*, *g*, *g*, arteries. The direction of the current is indicated by arrows. Compare pp. 762 and 819.

Fig. 8. A small specimen of *Sepia officinalis* L., p. 829; after CARUS *Nov. Act. Acad. Cæs. Natur. Curios.* XII.; *a*, *a*, *a*, *a*, *a*, *a*, *a*, *a*, the eight conical arms, the two long thin arms are seen at *b*, *b*; *c*, funnel; comp. pp. 818, 819.

Fig. 9. Detached arm (*Hectocotylus*) of a male individual of *Argonauta argo* serving for copulation (magnified about three diameters); after KOELLIKER (*Berichte der Zoot. Anstalt zu Würzburg*, 1849, Tab. I. fig. 19); comp. pp. 821—823.

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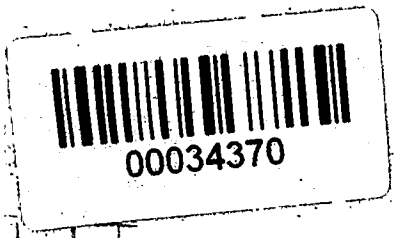
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